# MINING engineering

NOVEMBER 1960

REPORTS FROM THE WEST

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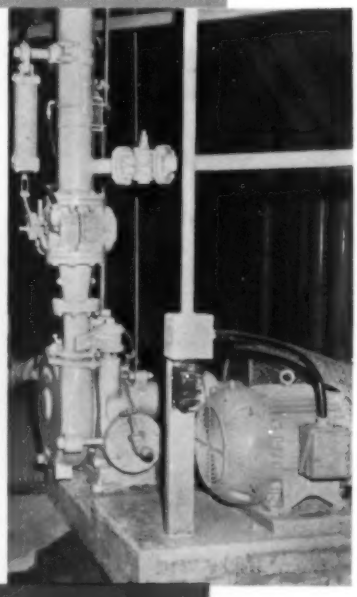

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## COMING EVENTS

**Nov.1,** Dinner meeting, Morenci Subsection, Longfellow Inn, Morenci, Ariz. Topic: Reforming of natural gas for reduction use in copper smelters. Speaker: L. Klein, Douglas Branch, Phelps Dodge Corp.

**Nov. 3-5,** Annual meeting, New Mexico Mining Association—Southwest International Mining Association, La Fonda Hotel, Santa Fe, N. M.

**Nov. 4,** AIME Pittsburgh Section, Off-the-Record meeting, Penn-Sheraton Hotel, Pittsburgh.

**Nov. 4-5,** Joint meeting, AIME Central Appalachian Section and West Virginia Coal Mining Institute, Greenbrier Hotel, White Sulphur Springs, W. Va.

**Nov. 7-10,** Soc. of Exploration Geophysicists, annual international meeting, Galveston, Texas.

**Nov. 15-16,** Anthracite Conference, technical and scientific aspects of anthracite utilization, The Pennsylvania State University, University Park, Pa.

**Nov. 18,** American Mining Congress, coal division conference, Penn-Sheraton Hotel, Pittsburgh.

**Dec. 3,** AIME Colorado Plateau Section, technical meeting, election of officers, WAAIME dinner-dance, Grand Junction, Colo.

**Dec. 5,** AIME Arizona Section annual meeting, Pioneer Hotel, Tucson, Ariz.

**Dec. 5,** AIME Boston Section, Richards Night. Topic: New Developments in Mineral Processing. Speaker: Robert M. Garrels, Professor of Mineralogy, Harvard University.

**Dec. 6-8,** 19th Electric Furnace Steel Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

**Dec. 7,** Symposium on Developments in Coal Mining, Equipment, and Methods in Illinois; also, "The Stora Kaldo Process." Chicago Section, AIME.

**Dec. 12-14,** National Conference on Water Pollution, Public Health Service, Washington, D. C.

**Dec. 26-31,** Annual meeting, American Association for the Advancement of Science, Boston, Mass.

**Jan. 18, 1961,** Third AIME Mechanical Working Conference, "Bar and Shaped Products," Penn-Sheraton Hotel, Pittsburgh, Pa.

**Jan. 25-27,** Instrumentation Symposium, for the Process Industries, Texas A & M College, College Station, Texas.

**Feb. 22-25,** International Symposium on Mining Research, sponsored by U. S. Bureau of Mines and Missouri School of Mines and Metallurgy, Rolla, Mo.

**Feb. 26-Mar. 2,** AIME Annual Meeting, Ambassador and Chase-Park-Plaza Hotels, St. Louis.

**April 10-12,** 44th National Open Hearth Steel Conference and Blast Furnace, Coke Oven, and Raw Materials Conference, Sheraton Hotel, Philadelphia.

**Apr. 12-14,** International Symposium on Agglomeration, sponsored by SME, SPE, and TMS of AIME, Hotel Sheraton, Philadelphia.

**April 26-27,** AIME Technical Conference on High-Temperature Materials, Carter Hotel, Cleveland.

**Sept. 17-20,** Commemoration of the 50th Anniversary of Froth Flotation in the U.S.A., sponsored by AIME: Society of Mining Engineers' Mineral Beneficiation Division, Cosmopolitan Hotel, Denver.

**COVER ART**

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# MINING engineering

**VOL. 12 NO. 11** **NOVEMBER 1960**


**COVER** *To salute the meetings held by mining men in the month of October artist Herb McClure has portrayed a scene from an underground mine—the "home" of many mining engineers. Summaries of four major meetings can be found in a special section of this issue commencing on page 1177.*

### REPORTS OF WESTERN MEETINGS


**1177** Rocky Mountain Minerals Conference

**1179** AMC Mining Show

**1182** Symposium on Surface Mining Practices

**1183** Drilling and Blasting Symposium


### ARTICLES


**1161** Magnetic Roasting of Iron Ores in a Traveling Grate Roaster • *H. H. Wade and N. F. Schulz*

**1166** Suralco's Bauxite Handling System • *J. G. Cazort, Jr., and J. J. De Witte*

**1170** Geochemical Prospecting Methods Employed in Canada's Glaciated Precambrian Terrains • *John E. Riddell*

**1172** Plexiglas Mine Model • *George E. Erdman*

**1174** Letter to the Editor • *William G. Wood*

**1175** Successful Application of the Gravitational-Inertial Classifier


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**1159** Drift: Note From A Former "Drift" Writer • *Edward H. Robie*

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### FEATURED ITEMS


**1156** Last Chance to Order 1960 SME Preprints

**1177** Reports from Western Meetings

**1185** News of Annual Meeting (1961, St. Louis) Plans



MINING ENGINEERING staff, Society of Mining Engineers, and AIME Officers are listed on the *Drift* page.

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# PERSONNEL

THESE items are listings of the Engineering Societies Personnel Service Inc. This Service, which cooperates with the national societies of Chemical; Civil; Electrical; Mechanical; Mining, Metallurgical, Petroleum Engineers, is available to all engineers, members and nonmembers, and is operated on a nonprofit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 60 pct of the first month's salary if a nonmember, or 50 pct if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number. When making application for a position, include 8¢ in stamps for forwarding application to the employer and for returning when possible. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance. Local offices of the Personnel Service are at 8 W. 40 St., **New York 18;** 57 Post St., **San Francisco;** 29 E. Madison St., **Chicago, 1.**

**In addition to the listings below, ESPS maintains a more complete file of general engineering positions and men available. Contact nearest ESPS office, listed above.**

## MEN AVAILABLE

**Mill Superintendent, Metallurgist,** B.S. in chemistry, M.S. in metallurgy, 43. Nine years in charge of Pb-Zn concentrator; all mill positions including shift boss and assistant mill foreman in Cu-Zn mill. Also assaying copper, Au-Ag for smelter and refinery. Seven years director of mineral dressing sales. $9600. Prefer West or foreign. Home: Arizona. Se-1335.

**Exploration or Mining Geologist,** B.S. in geological engineering 1950. Ten years experience in Australia, western U.S., and the Philippines in mining and exploration. Work has included direct supervision of 60 men and several hundred thousand dollars' worth of equipment. Location open. M-564.

**Mine Manager,** mining engineer, age 46. Broad background in underground and open pit mine operations, plant construction, and mine evaluation in the U.S., Canada, and South America. M-565.

**Mining Engineer,** Penn State University graduate. Four years experience construction and research. Prefer South. M-566.


**FOR SALE: 400 Patented precious metal mining properties. Located in the rich Silverton, Colo., mining district. Price: one half the cost of patenting and title to this property. H. C. SPRINKLE, Owner, Durham, N. C.**

**MILL SUPERINTENDENT—Mining degree required. Must have total of 12-15 years' milling and underground mining experience. Salary open. Location east.**

**MINE ENGINEER—Two to five years' experience. Duties will include underground surveying, ore reserve and cost studies. Eastern U.S.**

**Write to:**

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**MINING ENGINEERING**
**29 West 39th Street**
**New York 18, N. Y.**


**Mining Engineer—Geologist,** age 34. Ten years in exploration and production at hardrock, placer, ore-handling, and mineral dressing operations; seasoned to foreign work. Good working knowledge of Spanish, French, Italian, and Arabic. Prefer foreign as engineer and/or geologist or technical representative. M-567.

**Geologist—Mining or Exploration,** M.S. degree in geology. Ten years experience in western U.S. and Africa; exploration, production, metalliferous, underground. Location open, prefer West. M-568.

**Assistant Manager,** metallurgical engineer. Twenty years mining, milling, and smelting experience in U.S. and Latin America in production, research, and management. Prefer Latin America.

**Executive Engineer, Chief or Project,** age 54. Background includes supervision of design and construction of highways, structures, complete processing plants, and recent missile launching sites. Prefer Chicago but location open. Available immediately. M-1176-Chicago.

**Manager—Assistant Manager,** B.S. metallurgy, mining. Age 31. Engineer in complete charge of small mine, mill. Production foreman gypsum rotary calciner, kettles, board plant. Engineer, board and block mill. Engineer in charge of capital expenditures in mill, quarry, mine board plants, main office. Prefer Midwest-West. M-1181-Chicago.

**Manager, Superintendent, Assistant Manager,** B.S. in mining engineering, age 51. Four years directing underground operations; gold, manganese; 4 years open pit nickel mine; 2 years directing location, operations, production control; 6 years efficiency engineer copper mine; 10 years engineering, exploration, and production in mining. M-1182-Chicago.

**Jr. Geologist,** M.S. in geology, age 30. Summer experience in oil exploration. Seeking challenging job in petroleum, mining, or allied field. Available immediately. Location open. M-1183-Chicago.

**Geologist,** B.S., M.S. in geology, age 34. Four years with USGS in commodity work; 4 years commodity studies and mineral exploration for northern landholder. Some similar foreign work. Bibliography. Prefer West or Midwest. M-1184-Chicago.

**Mining Engineer,** B. S. in mining engineering, age 25. Three years underground coal mining including mine design and layout, application of modern equipment, ventilation, surveying, mapping and equipment design; 11 months highway department. Desire production or engineering assignment, preferably U.S. or Canada. M-1185-Chicago.

**Exploration or Production Manager,** B.S. in mining engineering, age 46. More than 20 years experience in exploration, development, and production management in both metallic and nonmetallic mining and beneficiation. Will travel as needed. Prefer U.S. M-2001-Chicago.

**Exploration or Mine Manager,** geologist, 37. Ten years experience including exploration, mine geology and engineering; exploration and mine management; and extensive property evaluations. Exceptional exploration record. $10,000 to $12,000. Any location. Home, New Mexico. Se-196.

**Construction Manager,** mining engineering, 46. Twenty years experience in charge of construction of tunnels, concrete plants, harbor and dock works (including mechanical and electrical, pile driving, dredging, building, heavy concrete) surface and subsurface facilities for mining and smelting companies. $18,000. Prefer South America, Orient. Home, Washington. Se-1769.

**Plant, Metallurgical Engineer,** MetE, 35. Six years experience in plant maintenance, new construction design and erection, process development and improvement, instrumentation of zinc smelter; development engineer on titanium production. Two years supervising melts and casting procedures of steel foundry. $7800. Prefer San Francisco Bay area. Home, California. Se-1831.

## POSITIONS OPEN

**Mining Engineers,** a) *Mill Superintendent,* graduate mining, with total of 12 to 15 years underground mining and milling experience. b) *Mine Engineer* with 2 to 5 years experience. Duties will include underground surveying, ore reserve, and cost studies. Salaries open. Eastern U.S. W9634.

**Flotation Engineers,** a) *Engineer-Mill Superintendent,* experienced flotation expert, who understands art of processing pegmatite ores by means of flotation reagents. One hundred tons of pegmatite ore per 24-hr day mill, 7 days per week. b) *Assistant Mill Superintendent.* c) *Foreman.* Personnel should be experienced in pegmatite flotation mill processing. Midwest. W9610.

**Mining Engineer** with about 10 years experience, to plan underground development and take care of engineering required ir. such an endeavor. Open pit mine; however, will go underground in near future. About $8000. Arkansas. W9605.

**Plant Superintendent, 30 to 40,** for large crushed stone and bituminous concrete manufacturing company. Engineering background desired. Salary commensurate with experience; excellent employe benefits provided by company. Some travel. Pennsylvania. W9561.

**Mining Engineer,** graduate, with underground experience in bituminous coal mines, engineering planning, layout of mining systems, design and construction work, mine mapping, and general engineering problems. $8000 to $9000. East. W9555.

**Mine Superintendent,** mining engineer, 30 to 40, 5 to 8 years experience in open pit mining. Knowledge of earth-moving equipment. To supervise mining operations, responsible for efficient operation cost and equipment. Under research manager. $8,000 to $10,000, depending on experience. Jamaica. Sj-5567.

**Mill Shift Boss,** prefer single, with some knowledge of Spanish and some technical training. Experience on Pb-Zn flotation required. $4500 to $4800, plus room, board, and traveling expenses, usually 10 pct bonus at year end. Apply by letter. Central America. Sj-5571.

**Mine Engineer,** graduate and some experience either in underground nonmetallics or deep coal mining. For production planning, cost forecasting, layout of mining systems, design of installations such as conveyors, shafts, raises, etc.; also routine mine operating problems. For mine engineering staff of 11. 14,000 tpd. Salary open, depending on experience. Southwest. Sj-5538-R.

**Resident Engineer,** graduate, prefer to 55. Senior status and recent experience at substantial level in providing liaison, acceptance and inspection between design engineering and construction. Will engage in development of whole property from prestressed concrete dock for materials removal and handling; provide for ultimate shipment. Desirable that he be informed concerning mining properties including roads, structures, buildings, and long conveyors. Prefer knowledge of Spanish and have some Latin American experience. To treat with both design and construction. For engineering contractor. $11,000 base plus 1½ months' annual bonus, living allowance; without young children. Two-year contract. South America. Sj-5553.

# BOOKS

**Mine Examination Reports Valuation** by James H. Pierce and Thomas F. Kennedy, *Pierce Management Corp.,* Scranton Electric Bldg., Scranton, Pa., 255 pp., $10, 1960—This text consolidates practical experience and technical knowledge to produce a sound guide to the valuation of coal property. Part one discusses the examination of coal mines, defining the responsibility and qualifications of the mining and the examining engineers, the scope, techniques, and economic considerations of the examination, and estimation of production costs. Part two covers the valuation of coal properties, giving depletion and valuation principles, formulas, tables and methods, describing the development of mines

*(Continued on page 1140)*

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When A-C engineers recommend a shell liner for your grinding mill operation, you can be sure of one thing: it represents years of experience in all phases of mill operation. The first step in determining the right type is a four-point metallurgical and wear pattern analysis. Here are the four points:

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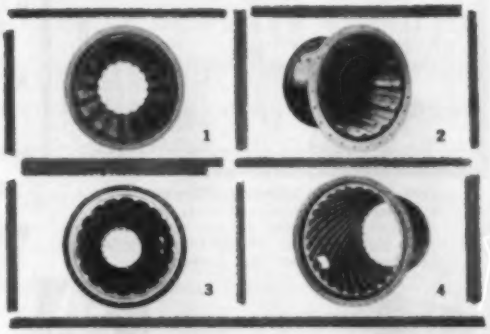
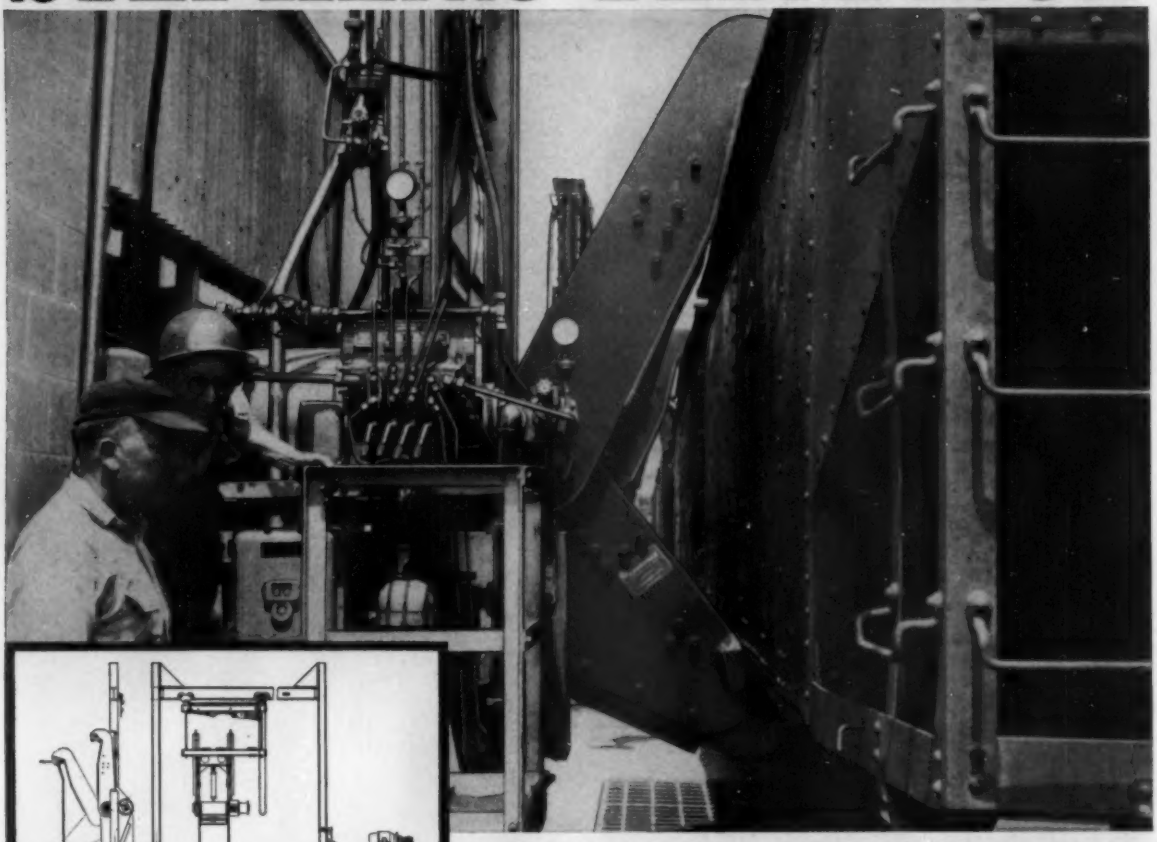
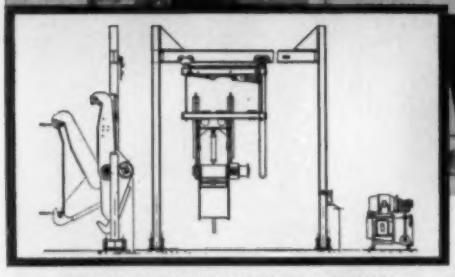
The right liner lasts longer — and often increases the capacity of your mill. *Ask your A-C representative to look into your shell liner problems, or write* **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin.* A-1366




These four types of liners demonstrate how liners can vary over a wide range of design characteristics to meet the specific requirements of a job. Pictured: (1) Lorain liner, (2) wave type, (3) wedge type and (4) spiral liner.

# STEPHENS-ADAMSON





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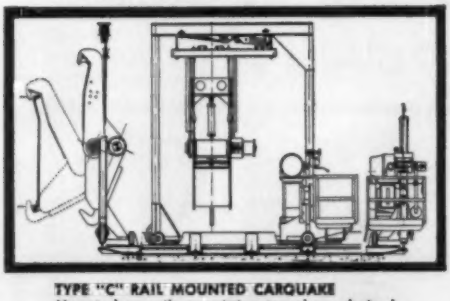

**TYPE "C" RAIL MOUNTED CARQUAKE**
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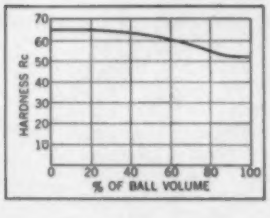


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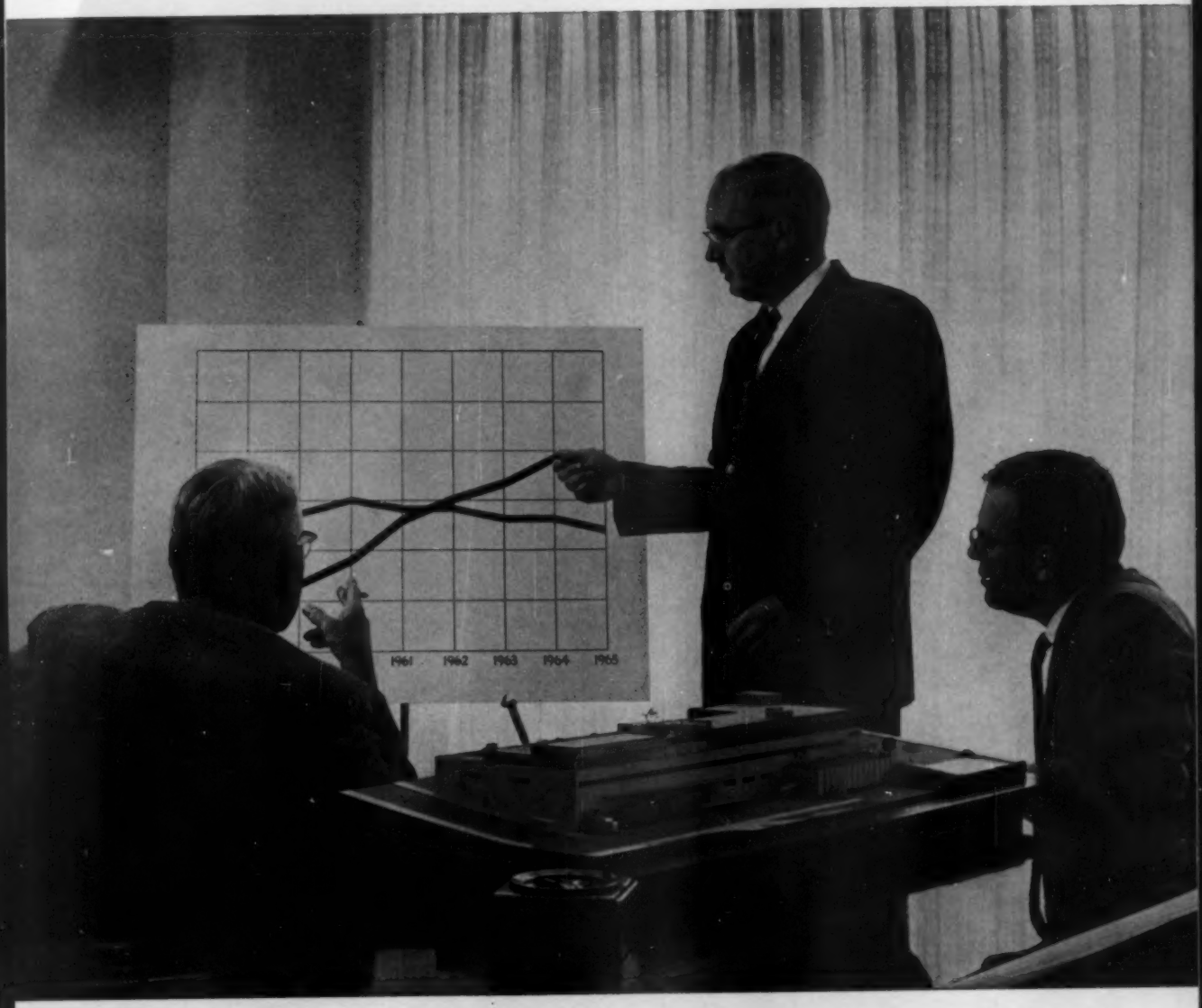


**Profitability?** Faced with the decision to expand your plant facilities, you should first determine whether all elements combine to form a pattern of future profitability. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. The studies and evaluations furnished by KE Pre-Engineering represent only one phase of total KE services. Kaiser Engineers is an experienced designer and builder of all types of facilities for the Minerals industry. From Pre-Engineering through design and construction, Kaiser Engineers provides complete one-company service and ingenuity based on years of experience.

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# Mineral Information

## An International Directory of Engineering Source Material

BOOKS

(Continued from page 1134)

*Order directly from the publisher all books listed below except those marked • • • The books so marked (• • •) can be purchased through AIME, usually at a discount. Address Irene K. Sharp, AIME Book Dept., 29 W. 39 St., New York 18, N. Y.*

and mine properties, and discussing royalty rates and tax valuation. • • •

**A History of Metals** by Leslie Aitchison, *Interscience Publishers, Inc.*, 250 Fifth Ave., New York 1, N. Y., 2 volumes, 607 pp., $30, 1960—This book traces the history of metals from the later stone ages to the age of nuclear fission, with the discoveries of new metals, processes, alloys, and uses throughout the ages cited by way of illustration. The work is of interest to historians and archaeologists as well as to metallurgists, for it is not a history of technical procedures, but is rather an account of the uses and processes of metals technology in its historical perspective. Volume I covers the seven earliest known metals, the alloys known in antiquity, and methods of processing them before machines were used. Volume II describes the revolution effected by machine power and exploration to uncover and eventually to create new metals and to provide more effective processing methods for metallic materials. • • •

**Geology of the Industrial Rocks and Minerals** by Robert L. Bates, *Harper & Bros.*, 441 pp., $10, 1960—This book emphasizes the occurrence, origin, and geologic interrelations of nonmetallics, utilizing an original classification based on economic factors. The introduction presents fundamental factors such as terminology, the role of the geologist, and trends in technology and research, and evolves the classification. The remainder of the book deals in detail with the various types of deposits as classified previously: part two, with industrial rocks (igneous, metamorphic and sedimentary); part three, with the industrial minerals (igneous, vein and replacement, metamorphic, sedimentary, and various minor types). • • •

**Principles of Geochemical Prospecting** by I. I. Ginzburg, *Pergamon Press*, 122 E. 55th St., New York 22, N. Y., 311 pp., $10, 1960—Hydrochemical, biogeochemical, and geobotanical methods of prospecting for the various kinds of ore deposits in igneous, metamorphic, and sedimentary rock and in surficial (residual) blankets, are discussed, preceded by a history of the development and a generalized treatment of the principles of geochemical indicators. Two chapters are devoted to haloes and other anomalies in overburden and soils. There is a lengthy bibliography, mainly Russian publications. • • •

**Fuel Engineering Handbook, Section B-5, Power Plant Cost Charts,** *Bituminous Coal Institute*, 1130 Seventeenth St., N. W., Washington 6, D. C., gratis, 1960.—A simplified, graphic method that permits a rapid approximation of boiler plant and electric generating facility construction costs, on a predesign basis, is explained in this section of BCI's newly released handbook. Individual copies of Section B-5 will be furnished by BCI upon request. A detailed list of handbook sections is also available from BCI.

**Resources Development: Frontiers for Research,** edited by Franklin S. Pollak, *University of Colorado Press*, Boulder, Colo., 315 pp., $3.75, 1960.—This volume contains the papers presented at the 1959 Western Resources Conference, which had as its theme "Building toward a continuing program of graduate study and research in the conservation and development of the resources of the West." The 23 articles cover such topics as: an evaluation of the West's land policy and development, atomic energy as a resource; potential application of new water technology; changing patterns of land use; better planning of river systems; potential of the Western metal mining industry; opportunities for graduate study and research; and the need for greater inter-institutional cooperation.

**Coal Mine Directory,** *McGraw-Hill Publishing Co. Inc.*, 272 pp., $20, 1960.—This annual volume lists all active coal mines that produce 50,000 tons or more per year in the U.S. and Canada. There are cross-listings showing changes in names of operating companies since the last edition; company affiliations, alphabetical indexes of all mines and companies, and executives; a geographical index; total number of companies, mines, and annual tonnage are shown for each state. Also available at $10 per copy are geographical section directories for the following areas: 1) Pennsylvania Maryland, Ohio, and northern West Virginia; 2) Virginia, southern West Virginia, eastern Kentucky, Tennessee, and Alabama; 3) Illinois, Indiana, and western Kentucky; 4) western U.S. and Canada. • • •

**Principles of Optical Crystallography** by A. V. Shubnikov, *Consultants Bureau Enterprises Inc.*, 227 W. 17th St., New York 11, N. Y., 186 pp., $9.50, 1960.—The author of this monograph is director of the Institute of Crystallography of the Academy of Sciences of the USSR and head of the crystallography and crystallophysics department at Moscow State University. He is well known for his work in crystallography. The work should prove of interest to scientists in the field in view of the widely held opinion that Soviet research into the mechanical and optical properties of crystals is more extensive and possibly moving ahead of the West in several areas. Chapters deal with basic ideas from the optics of isotropic transparent media, double refraction, interference of light crystal plates, rotation of the plane of polarization, elliptical polarization and elliptical double refraction, conical refraction, and double absorption of light in crystals. The work is translated by a bilingual scientist and is illustrated with photographs, diagrams, and tables. • • •

**Cost Engineering in the Process Industries,** edited by Cecil Chilton, *McGraw-Hill Book Co., Inc.*, 502 pp., $11, 1960.—The facts and data needed for making economical cost and profit-ability analyses in the process industries are presented in this book. It discusses accepted methods, specific data, and essential principles useful for making estimates of plant, equipment, and operating costs; for predicting both expected earnings and required capital investment; and for making management decisions at the optimum profit level for a com-

pany. Of special interest are useful cost indexes to keep the data up to date. Many illustrations, graphs, and tables supplement the discussions. • • •

**Handbook of Geophysics,** Revised Edition, *Macmillan Co.*, $15, 1960.—Sixty experts collaborated in the preparation of this encyclopedic source of geophysical information, which contains many tables, figures, and references to other publications. Included are papers on model atmospheres and atmospheric pressure, density, composition and electricity; atmospheric exploratory devices and acoustic propagation; temperature, wind, precipitation, clouds, visibility, the sun, meteors, and the ionsphere; thermal and cosmic radiation; electromagnetic wave propagation and geomagnetism; terrestrial surface parameters and jet aircraft condensation trails. • • •

**Canadian Mines Handbook** 1960, *Northern Miner Press Ltd.*, 116 Richmond St. West, Toronto 1, Canada, 312 pp., $3 paper, $5 hardcover, 1960—This edition lists over 3500 companies, including more than 200 new organizations. All pertinent statistical data concerning directors, capitalization, and financial position of Canadian mining companies are provided. First quarter production and earnings, latest dividends, and the most recent information on operations and mine development, where available, are shown. Special sections include: Metal Mines Classified, which lists producers and their metals; Range of Mining Share Prices, covering highs and lows from 1953 to May 31, 1960, for mining stocks listed on the Toronto, Canadian, and Vancouver stock exchanges; and a 28-page colored section of mining maps. • • •

**Geophysical Surveys in Mining, Hydrological and Engineering Projects** *European Assn. of Exploration Geophysicists*, 624 S. Cheyenne, Tulsa, Okla., 280 pp., $3, 1958.—This volume is devoted to case histories of mining exploration projects, water investigations, and civil engineering problems. Of the 21 papers presented, 13 are concerned with mining problems from many countries, covering a wide variety of geological conditions. Three papers discuss the important problem of water investigations and the use of electrical techniques; the remainder deal with civil engineering problems, mainly dam sites.

**Clays and Clay Minerals,** edited by Earl Ingerson, *Pergamon Press*, 122 E. 55th St., New York 22, N.Y., 369 pp., $8.50, 1960—This book consists of 24 papers, presented in no particular order. Nine discuss aspects of clay deposits in various areas of the U.S., for example, the Atlantic Coastal Plain, the Gulf of Mexico area, Virginia, Kentucky, Indiana, and Colorado. Several others discuss the properties of particular clay minerals, such as illite and vermicullite; pastes; clay minerals under particular conditions, e.g., under dehydration, in suspension, and in saline waters; or special groups, such as the montmorillonite group. Of the papers dealing with particular processes, two may be cited as examples—one on the use of X-ray techniques in quantitative analysis and diffractometry and another on a glycerol retention method of measuring external surface area. Also included is a review of selected clay mineral research in Yugoslavia. • • •

**Methods and Techniques in Geophysics, Volume I,** edited by S. K. Runcorn, *Interscience Publishers Inc.*, 250 Fifth Ave., New York 1, N.Y., 374 pp., $10, 1960—A collection of papers on modern physical techniques for determining and using physical information about the earth. Contributors from the U.S., Canada, and Britain discuss measurement of temperature gradient in the earth, heat flow over land, geomagnetic elements, gravity at sea, and paleomagnetism. Other subjects covered include earth currents and the detection of earth movements; borehole surveying; properties of rock under high temperature and pressure; and the latitude, longitude, and secular motion of the pole. • • •

*(Continued on page 1146)*

Adv. No. 152

# Longyear

**PRODUCTS:** Diamond core drilling equipment and supplies (center: *Unitized* Longyear "24" drill rig on 4-wheel-drive Jeep) . . . Longyear diamond bits . . . Longyear multi-speed drilling pumps . . . Longyear Wire Line.

**WORLD WIDE SERVICES:** *Contract Drilling*—Wire Line and conventional core drilling by experienced drill crews with modern equipment—to date: over 1 million feet with Wire Line . . . *Consulting*—Geological and mining consultation . . . Air Photo Interpretation (photogeology, road and site planning) . . . Valuation of mining property for loans, leases, sale . . . Mineral exploration and appraisal.

**E. J. LONGYEAR COMPANY**
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**Allis-Chalmers boosts work hours, cuts costs with the best tractor undercarriage in the business. You get industry's toughest track... best designed track guards ... certified, permanently lubricated truck wheels, idlers, support rollers.**

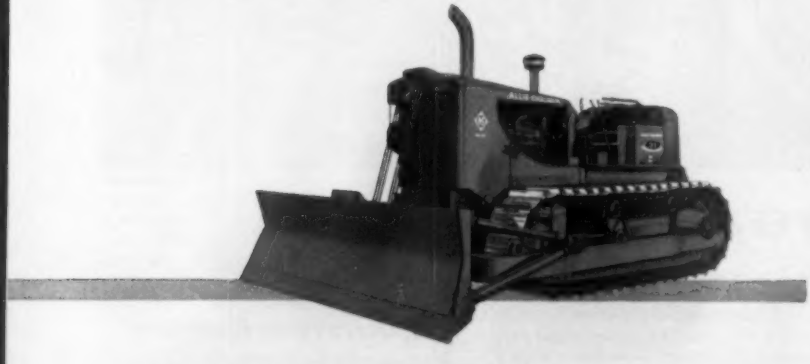
Next time you watch track shoes squeal and grind against jagged rock . . . or see 'em buried sprocket-deep in mud, consider this: Nothing slugs it out with tough conditions like an Allis-Chalmers tractor undercarriage.

Specially heat-treated track shoes, side bars, track pins and bushings are the industry's toughest. Bushings extend into counterbored side bars to seal out dirt, provide more bearing area.

Track guiding truck wheel guards provide a deep-flanged guide channel that keeps track riding true on sprockets, idlers and truck wheels even in the roughest and toughest going. The solid A-frame holds the truck frames in absolute alignment — keeps track running straight.

PERMA-SAFE truck wheels, idlers and support rollers on all Allis-Chalmers tractors roll on tapered roller bearings, are protected against dirt and moisture by Positive Seals. Factory-lubricated, they're certified never to need further greasing.

We invite a maintenance cost comparison with any other tractor undercarriage. We further invite you to inspect the Allis-Chalmers healthy, long-lived tractor engine, the all-steel main frame, double-reduction final drives and many other cost-cutting features. Your Allis-Chalmers dealer will be happy to give you full details. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.



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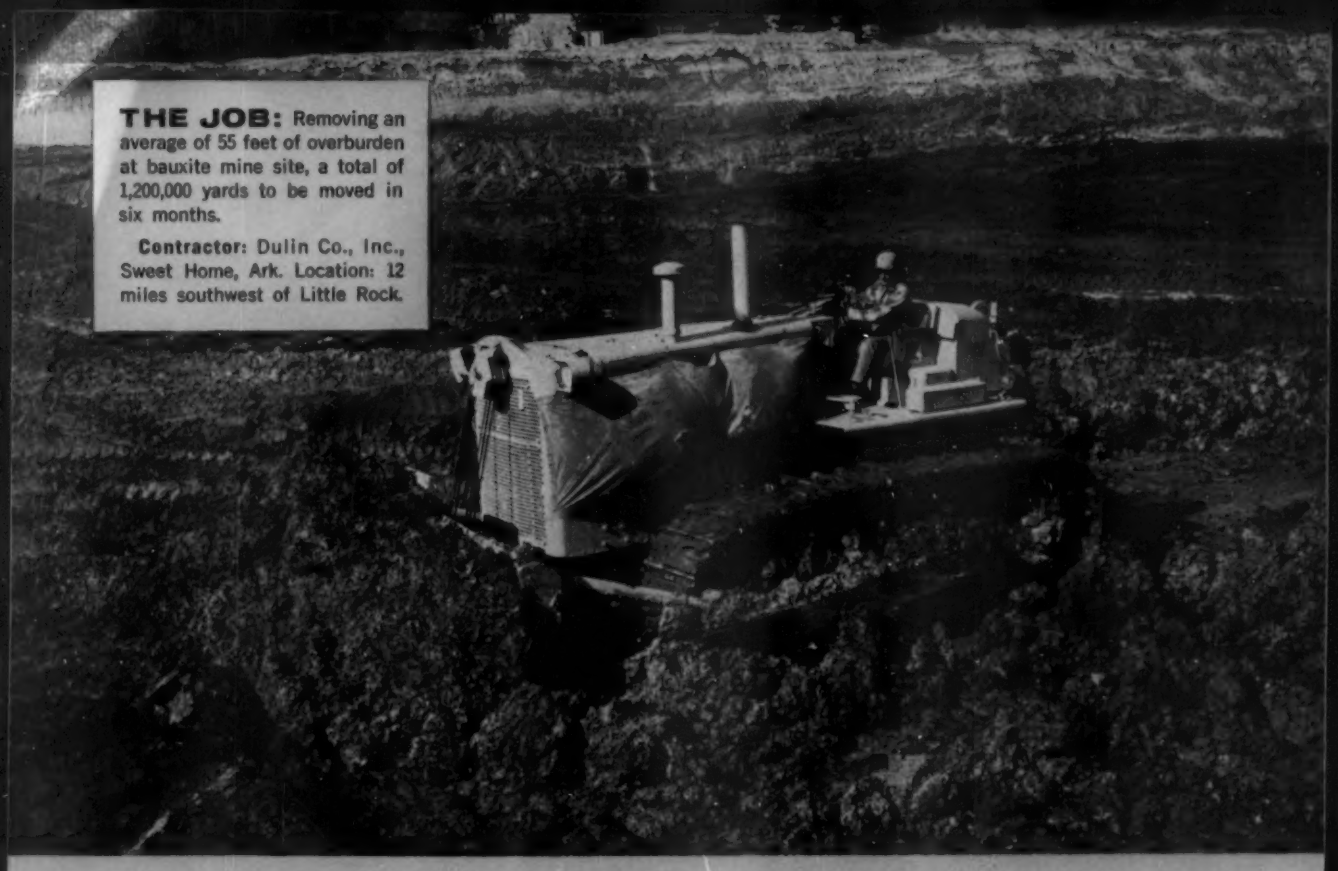
21


**THE JOB:** Removing an average of 55 feet of overburden at bauxite mine site, a total of 1,200,000 yards to be moved in six months.
**Contractor:** Dulin Co., Inc., Sweet Home, Ark. Location: 12 miles southwest of Little Rock.

Here's how Superintendent Clyde Moore rates one of several Cat units on this job, a 235 HP Cat D8 Tractor after 1700 hours of operation: **"It's the best D8 we've ever had. It has more power, it's easier to operate. And the extra clearance lets it work in mud and conditions other tractors wouldn't dare start through. The wider pads and bigger tracks really give it flotation and traction. The lifetime lubricated track rollers are a time-saver—you don't have to worry about too much or too little oil or grease. (These rollers never need lubrication until rebuilding.) Before we moved to this job, we had the D8H working in sand and abrasives. The tracks and rollers on the other tractor were completely worn out. But the tracks and rollers on the D8H showed almost no wear—they really last. And it still has the same cutting edges that came with the dozer. Besides working in the field, our D8 is used for cutting ridges and dozing out soft muck and sand."**

See this new machine at your Caterpillar Dealer. Prove to your own satisfaction with an on-the-job demonstration that the new D8H is easy to operate, economical to own, and ready to set production records.

**WITH THE NEW POWER SHIFT TRANSMISSION (OPTIONAL) THE D8H MOVES DIRT EVEN FASTER**

- Shifts on the go under full load in a split second
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Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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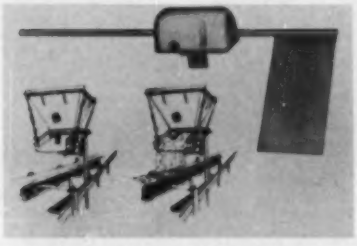
**THE D8H... HIGH PRODUCTION TOP ECONOMY**

# MANUFACTURERS NEWS

## NEWS / EQUIPMENT / CATALOGS

### Flow Switch

*Syntron Co.* has designed Model FS-1 flow switch to respond to lack of material at a critical point in a bulk material handling system and automatically correct the difficulty or sound an alarm. Flow of material deflects a flap which holds switch



out of operating position; when material flow ceases, flap swings down and actuates the switch. The switch may also start an electromagnetic bin vibrator to break down arching or plugging, or it may start or stop a vibratory feeder supplying a bin. **Circle No. 1.**

### Scraper

Model TS-14 twin-power scraper with 14 cu yd struck capacity and 20 yd heaped SAE rating at 1:1 slope is now available from *Euclid Division* of *General Motors Corp.* This all-wheel drive scraper is powered by two engines with a total of 296 hp on grades and long hauls. All

scraper operations are hydraulically and independently controlled. The cutting edge consists of four adjustable sections that are identical and reversible. **Circle No. 2.**

### Activated Bin

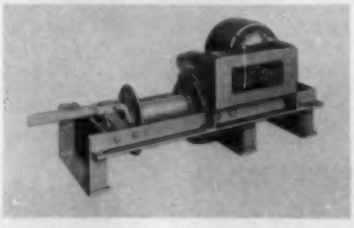
*Vibra Screw Feeders, Inc.* has designed its "Live Bin" to permit clean discharge of materials with poor flowing qualities, such as moist sand, asbestos fibers, etc. Basically a storage bin suspended on live rubber mounts and equipped with a vibrating external activator, the unit is reported to permit maximum hopper capacity with a bin bottom that may be made nearly flat. The activated bin is also reported to be applicable to any hopper size and to offer high amplitude of movement at the bottom. **Circle No. 3.**

### Blue Print File

*Momar Industries* is now supplying a handy all-steel vertical blue print file. Termed the "Glider 1200", the frame is 32 in. long, 36 in. deep, and 60 in. high. The open file is capable of holding up to 1200 individual blueprint sheets vertically on clamps which can be slid in or out of rigid channel tracks in the frame. **Circle No. 4.**

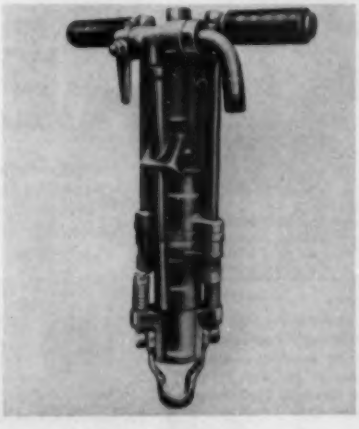
### Winches

*Stanspec Corp.* has announced their new line of winches ranging from 500 to 30,000-lb capacity in 24 standard models with electric, air, gasoline, or hydraulic power. Termed "Rightway" winches, the units feature gear reductions in oil bath lubrications, automatic mechanical load brakes, and free spooling drums manufactured for all-weather use. **Circle No. 5.**



### Rock Drill

An all-purpose, 58-lb rock drill is now being marketed by the *Davey Compressor Co.* Named the "Silver Bullet", the unit features three-way throttle control and an automatic lubrication system. The overall length of the drill is about 24 in., and it has a 1x4¼-in. chuck and 2⅝-in. bore. Its reported high output working capacity allows the tool to be used for drilling both primary and secondary blast holes to 18-ft depths. **Circle No. 6.**



### Walking Dragline

*Bucyrus-Erie Co.* has increased their available number of dragline models to 12 with the recent introduction of the 1250-W. This machine, fully electric, embodies major new design

features which enable it to handle larger capacities at greater boom lengths which had previously been considered impractical from the engineering viewpoint. **Circle No. 7.**

### Throw-Away Bits

*Vascoloy-Ramet Corp.* has announced their development of new percussion bits designed for longer life and reduced cost per drill hole. With carbide inserts in alloy steel bit bodies and manufactured to the same specifications as other V-R percussion bits, they are available in 1⅜ in., 1½ in., and 1⅝ in. diam. **Circle No. 8.**

### Transit

The Brunson Engineer's Transit Model 50, a precision instrument featuring securely sealed, permanently lubricated ball bearing construction for lasting accuracy under all climatic conditions, is now being marketed by *Charles Bruning Co.* The axes of the transit are completely protected from dust and moisture. Bearings in spindle and telescope axis cannot bind, and the permanent, all-temperature lubricant will not leak or evaporate. The unit is reported to operate freely and accurately from —70°F to 160°F, and is not subject to effects from wind pressure, dust storms, etc. **Circle No. 9.**

## BOOKS

(Continued from page 1141)

### U. S. BUREAU OF MINES

*Request free publications from:*

Publications Distribution Section
U.S. Bureau of Mines
4800 Forbes Ave.
Pittsburgh 13, Pa.

**RI 5514** Strain Energy in Explosion-Generated Strain Impulses.
**RI 5518** Exploration of Lead-Zinc Deposits in the Ross Basin-Lake Como Area, San Juan County, Colo.
**RI 5519** Natural Gas-Air Burner for a Top-Fired Preheater.
**RI 5520** Sampling Stream Gravels for Tin, Near York, Seward Peninsula, Alaska.
**RI 5521** Extraction of Yttrium and Rare-Earth Elements From a Euxenite Carbonate Residue.
**RI 5523** Separation of Rare-Earth Elements in Bastnasite by Iron Exchange.
**RI 5524** Carbonizing Properties of Cambria County, Pa., Coals.
**RI 5525** Thermochemistry of Samarium.
**RI 5526** X-Ray Emission Spectrographic Analysis of High-Purity Rare-Earth Oxides.
**RI 5528** Kerosene Flotation of Coal: Semi-commercial Studies of Cell Performance.
**RI 5531** Extractive Metallurgy of Euxenite.
**IC 7932** Control of Fires in Inactive Coal Deposits in Western United States, Including Alaska, 1948-58.
**RI 5527** Drying North Dakota Lignite to 1,500 Pounds Pressure by the Fleissner Process.
**RI 5532** Nickel-Cobalt-Iron-Bearing Deposits in Puerto Rico.
**RI 5535** Flocculation as an Aid to Filtration of Coal Slurry.
**RI 5537** Expanding Properties of American Coals Tested in a Sole-Heat Oven.
**RI 5539** High-Purity Tungsten by Fluoride Reduction.
**RI 5540** Preparation of Rare-Earth Chloride Solutions.
**RI 5522** Development and Operation of an Experimental Entrained-Solids, Oil-Shale Retort.
**RI 5536** Development of Equipment and Process for Extracting Cerium (IV).
**RI 5538** Fluorescent X-Ray Spectrographic Analysis: Studies of Low-Energy K, L, and M Spectral Lines.
**RI 5541** Pressure-Drop Measurements Through Beds of Granular Iron, Lathe Turnings, Steel Wool, and Parallel-Plate Assemblies.
**IC 7943** Loss of Life Among Wearers of Oxygen Breathing Apparatus (Revision of I. C. 7279).
**RI 5542** Irreversible Changes in Response of Minerals to Electrostatic Separation After Heating.
**RI 5543** An Electrolytic Method for Separating Nickel and Cobalt.
**RI 5544** Extraction of Yttrium and Rare-Earth Elements From Arizona Euxenite Concentrate.
**RI 5545** Bureau of Mines Gas-Combustion Retort for Oil Shale: A Study of the Effects of Process Variables.
**RI 5534** Electrowinning Tungsten and Associated Molybdenum From Scheelite.
**RI 5537** Chemical Analysis of a Calcined Kyanite From Kenya, East Africa.

### West Virginia

Geological and Economic Survey
P. O. Box 879, Morgantown, W. Va.
**A Symposium on the Sandhill Deep Well Wood County, W. Va.**, Report of Investigation No. 18, $1.50 plus 9¢ postage.

## ABSTRACTS

**In This Issue:** *The following abstracts of papers in this issue are reproduced for the convenience of members who wish to maintain a reference card file and for the use of librarians and abstracting services. At the end of each abstract is given the proper permanent reference to the paper for bibliography purposes.*

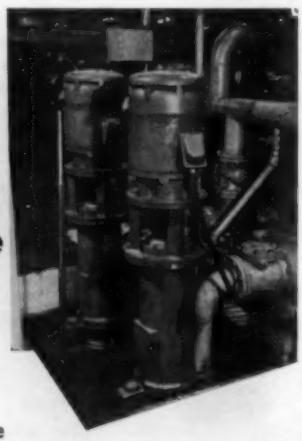
**Magnetic Roasting of Iron Ores in a Traveling Grate Roaster** by *H. H. Wade* and *N. F. Schulz*—An experimental traveling-grate roaster built and operated at Minnesota University's Mines Experiment Station has a proven dry-ore capacity of 1000 lb per hr, up to 4000 lb per hr under special conditions. The heat and reducing atmosphere required by the process is produced by combustion of natural gas and air in a burner designed as an integral part of the apparatus. Various low-grade iron ores, crushed to ⅝ in. or less, are agglomerated with water in a balling disc. The roaster converts their iron oxide contents to magnetite. **Ref.** (MINING ENGINEERING, **November 1960**) **p. 1161.**

**Suralco's Bauxite Handling System in Surinam** by *J. G. Cazort, Jr.* and *J. J. De Witte*—A report on methods of handling and transporting bauxite from the open pit at Orac to the beneficiation plant at Paranam, Surinam. The authors discuss the use of conveyor systems, cranes, and barges. **Ref.** (MINING ENGINEERING, **November 1960**) **p. 1166.**

**Geochemical Prospecting Methods Employed in Canada's Glaciated Precambrian Terrains** by *John E. Riddell*—The author presents results of a survey taken among 15 Canadian exploration companies as to the geochemical methods employed during 1959 in areas containing glacial debris. Although the companies surveyed indicated varying attitudes toward the effectiveness of geochemical prospecting in such areas, the author concludes that many glaciated Precambrian areas can be satisfactorily prospected for base metals by geochemical methods. **Ref.** (MINING ENGINEERING, **November 1960**) **p. 1170.**

(Continued on page 1153)


**gritty, corrosive solution doesn't faze these Nagle® pumps**



These two 5" type "SWOB" Nagle vertical shaft centrifugal pumps are giving excellent service in a Michigan metallurgical plant. They are designed to give years of service where ordinary pumps would give only months of service. All submerged parts are of corrosive and abrasion resistant materials. There are no bearings below the floor plate. No stuffing box to worry about. Pump entrance is at bottom of casing so that solids cannot settle around impeller when pump is not operating. Nagle "SWOB" pumps are available 1" to 8", capacities to 1800 GPM, heads up to 100'. Many of these pumps are cutting costs in chemical and metallurgical plants.

Nagle Pumps, Inc., 1225 Center Ave., Chicago Heights, Ill.

*Tough jobs call for:*
Nagle PUMPS
FOR ABUSIVE APPLICATIONS EXCLUSIVELY

Nagle builds a complete line of vertical and horizontal shaft pumps for handling abrasive, corrosive or hot slurries or liquids—send for Nagle Pump Selector.

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for large and small mines

Designers and Builders of
**KOEPE HOISTS**
for small mines, offering low first cost and operating economies.
Write for free reprints of illustrated article on small Koepe Hoisting Systems.

**MAYO MINE CAR COUPLERS**
are SAFE and AUTOMATIC

Mayo-designed, cast steel coupler for narrow gauge mine cars hooks on in seconds **automatically** from any position. Completely eliminates all hazards of hand coupling, saves time. Easily bolted to existing cars. Costs about half of comparable equipment.

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Steel Forms
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Muck Bins
Shields-Airlocks
Locomotives
Mine Cars
Grouters

**(21) ORE HAULER:** *Unit Rig & Equipment Co.* has issued a four-page leaflet illustrating its model 21A-64 PRD diesel electric ore hauler. A diagram of dimensional layout and specifications are included.

**(22) CORE DRILL:** A folder describing a strataprobe core drill equipped with hydro-pneumatic ram has been issued by *Pan Alaska Mining & Mfg. Co.* Photographs show the component parts of the drill, supplementing the written description. Detailed specifications are included. Payment plans, both for sale and rental of the equipment, are discussed.

**(23) ROCK FORKS:** *Drott Mfg. Corp.* has recently issued a single-leaf flyer describing its rock fork attachment for fast, easy handling of rock and heavy minerals. The rock fork is made of specially fabricated super-strong alloy steel and offers stubborn resistant to the abrasive action of loading and dumping heavy rock. Photos and drawings show the rock fork in action, and the unit's specifications are included.

**(24) CONVERSION FACTOR TABLES:** For convenient reference use by production, process, and instrument engineers is a new vest-pocket size plastic table of conversion factors dealing with weight-volume, gravity of light and heavy liquids, base weight, power, temperature, pressure, flow, and length-area issued by *The Ohmart Corp.*

**(25) THERMAL DRYING:** A reprint of an article from the June 1960 issue of *Mechanization*, "Money Saved by Thermal Drying" has been issued by *Dorr-Oliver Inc.* This four-page bulletin (Technical Reprint No. 7060) describes the increased output and reduced cost resulting from the installation of a single "FluoSolids" dryer at a coal preparation plant. Included are discussions of the process, equipment, plant operation and control, plus the operating results obtained with the dryer.

## FREE LITERATURE

**(26) TRACTOR TREAD LOADERS:** *Goodman Mfg. Co.* has available Catalog G-145 which details Series 960 loaders for high capacity loading of coal, gypsum, and potash. Complete with photographs and a cut-away diagram, this 8-page brochure depicts the use and advantages of underground automatic loaders.

**(27) CHECK-WEIGHING SYSTEMS:** A bulletin on check-weighing systems has been published by *Weighing & Controls Inc.* covering the various types of systems that can be assembled from a variety of platform scales, readout equipment, and control instrumentation which the company markets. Bulletin 50, entitled "Unitized Check-Weighing Systems" is a four-page booklet illustrated with photographs of components and block diagrams of typical systems.

**(28) CAR HANDLING SYSTEMS:** Bulletin 760 recently issued by *McNally Pittsburg Mfg. Corp.* describes various systems of handling railroad cars for loading material such as rock, gravel, coal, etc. Photographs, dimensions, drawings, and specifications are given for automatic loading systems, car hauls, and car retarders.

**(29) GRAVIMETRIC FEEDER:** Four page bulletin No. 0035.20-2 has been issued by *B-I-F Industries* covering the most up-to-date information on the Omega Hi-Weigh Belt Gravimetric Feeder for continuous feeding of large quantities of dry materials. The leaflet gives a detailed description of the feeder and its operation, including feeder performance specifications, principal dimensions, and accessories.

**(30) PORTABLE INDUSTRIAL LIGHTING:** *Joy Mfg. Co.* has issued a 12-page illustrated bulletin showing how portable lighting systems for practically every use can be quickly and easily assembled from *Joy's* industrial lighting components. Bulletin B76 provides information on types, construction details, and varieties of stock components from which individualized portable lighting systems can be assembled.

**(31) TILTING PAN FILTER:** An attractive eight-page bulletin (F-2038A) released by *The Eimco Corp.* describes how recent developments in the design of its tilting pan filter have made this specialized filter type increasingly useful in chemical and metallurgical processing. An interesting feature of the bulletin is a large visual representation of a single filtration cycle in color, showing time segments for wash, air sweep, cake discharge, and vacuum purge.

**(32) CRAWLER CRANE-EXCAVATOR:** *American Hoist & Derrick Co.* has issued an eight-page catalog, No. 790-CG-1, illustrating and describing the new "American 900" series crawler crane-excavator. A checklist of features and pictures of component parts are included.

**(33) RAILROAD CAR SHAKER:** A six-page folder, No. 2745, issued by *Link-Belt Co.* describes a new one-man operated railroad car shaker which incorporates a new low-frequency vibration shaker mechanism for fast, economical unloading of hopper bottom cars at the rate of 8 to 10 cars per hour. The leaflet includes a discussion of application considerations and selection.

**(34) LIQUID FEEDERS:** A four-page leaflet, bulletin No. 603, recently issued by *The Clarkson Co.* describes its "Model E" stainless steel feeder which is adjustable for precise feeding of liquids from a few drops to 2000 cc per minute. It is adaptable to remote, manual, or automatic control.

**mail this post card for more information**

11

**Mining Engineering** **29 West 39th St.** **New York 18, N. Y.**

Not good after February 15, 1961

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| 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | | | | | | |

Students should write direct to manufacturer.

**(35) SCREW FEEDERS:** The results from the testing of more than 400 different dry materials used on its screw feeders are given in an eight-page folder from *Vibra Screw Feeders Inc.* Names of the companies supplying the material, data concerning the material density, type and size of screw used, maximum rate in lbs per minute, and minute-to-minute accuracy of operation are also included. Issued as a guide to engineers responsible for process design and machine performance, the data is a result of thorough sampling and testing procedures. It offers a dependably accurate reflection of performance which can be expected from specific materials of known density handled by the firm's screw feeders in actual operation, and it serves as a handy tool for forecasting results while still in the planning stage.

**(36) TRACTOR:** A four-page, three-color brochure (Form CT-16/60) issued by *Napco Industries Inc.* features a new model "Crab" industrial tractor. Also included in the descriptions are a great variety of attachments. The brochure also lists complete specifications for both four and six-cylinder models.

**(37) INDICATORS, CONTROLS:** *U.S. Gauge*, division of *American Machine & Metals Inc.*, has issued six-page bulletin No. 3020 describing pressure gauges, thermometers, and control instruments manufactured by the company. Photographs illustrate the models, and information on dimensions, accuracies, construction features, and applications is given in the text.

**(38) VALVES:** *Homestead Valve Mfg. Co.* has available three reference book sections covering lubricated plug valves, "Cam-Seald" plug valves, and "Lever-Seald" plug valves. These valves are described in reference books 39-1, 39-2, and 39-3 respectively. For those interested in other types of valves the complete Homestead Valve Reference Book is available.

**(39) TIMING BELT DRIVES:** "Five Simple Steps to the Selection of Timing Belt Drives," an eight-page bulletin (No. 21103) issued by *T. B. Wood's Sons Co.*, gives a method involving a minimum of mathematics for the selection of a drive to fit any application. The bulletin includes five sets of curves for drive-width selection, developed by Wood's engineering department to eliminate tedious computation. A standard timing belt catalog is the only outside reference needed. A sample problem, given to illustrate the method of selection, is followed through the five steps involved.

**(40) FLUID FLOW RATE ALARMS:** Bulletin No. 175 issued by *Brooks Rotameter Co.* describes two types of alarms to be used with *Brooks* rotameters for signalling or simple control functions. The four-page leaflet contains photographs and diagrams of each alarm, explains its operation, and lists its features and specifications.

**(41) SPEED REDUCERS:** A new 36-page book (No. 2719) issued by *Link-Belt Co.* introduces the firm's completely redesigned and expanded line of parallel shaft reducers in 57 sizes, including 23 new sizes. Thoroughly illustrated, the booklet gives selection information complete with tables showing load classes and service factors. Sixteen pages of rating tables contain thermal and mechanical horsepower ratings for each input and output speed.

**(42) BULK MATERIALS HANDLING EQUIPMENT:** *Construction Machinery Div.* of *Clark Equipment Co.* has issued a four-color catalog describing its complete line of Michigan construction and bulk materials handling equipment. It contains details and full-color illustrations of tractor shovels, tractor dozers, tractor scrapers, tractor loggers, and excavator cranes. On-the-job photographs show the equipment in action on projects ranging from highway construction to logging operations.

**(43) VALVES:** Bulletin 606 CV issued by *The Clarkson Co.* describes its "Series C" valve for controlled flow of abrasive slurries and corrosive pulps. The four-page leaflet includes a flow chart and performance curves.

**(44) POLYDYNE DRIVES:** A two-color, 16-page booklet introducing the new line of "Polydyne" mechanical adjustable drives has been published by *General Electric.* Bulletin GEA-6806 discusses the principles of operation and configurations, and includes mounting positions, rating tables, and description of available accessories.

**(45) MOTOR GRADER:** Design and engineering features which contribute to high productive capacity and long life in the new Caterpillar No. 12E motor grader are discussed in a 12-page booklet just released by *Caterpillar Tractor Co.* This publication, booklet No. 33799, illustrates by photographs and drawings the components and operation of the grader and includes brief specifications.

**(46) ROTARY POSITIVE BLOWERS:** Bulletin S59-H from *Sutorbilt Corp.* describes and illustrates its "California Series" of horizontal and vertical blowers and gas pumps. The 12-page booklet explains how these pumps automatically provide a metered quantity of oil-free air at constant volume, even against variable pressure, assuring noncontamination of the transmitted product. Complete dimensional information on all models and sizes is given.

## New Films

*Z For Zepher*, a 15-min color and sound film produced by *Gardner-Denver Co.*, presents in detail the principles of rotary air drilling. A complete cycle of operation is shown from locating on the drill site, set up, drilling, and then relocating. Available on free loan from Gardner-Denver Co., Quincy, Ill.

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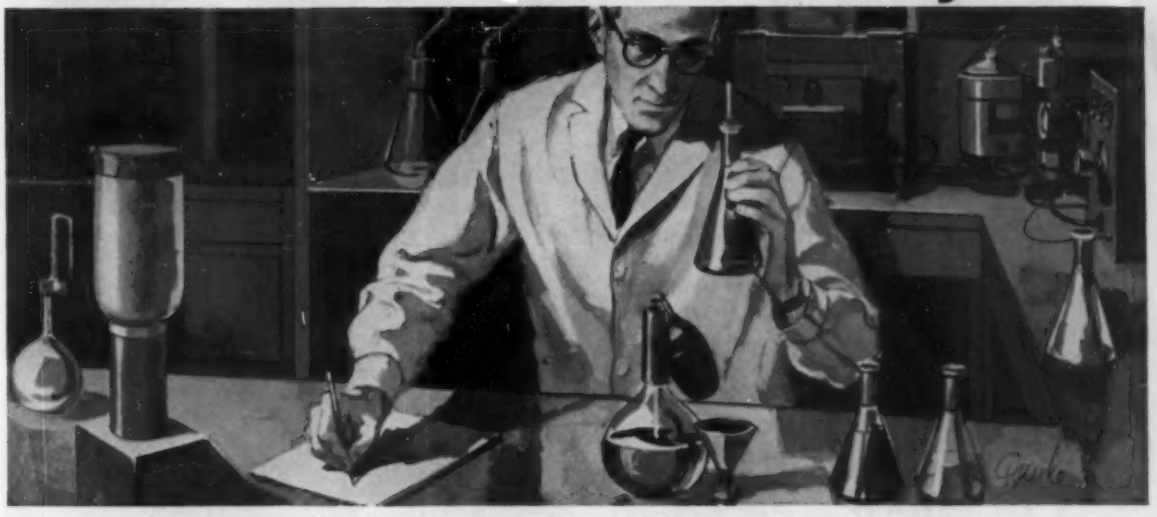

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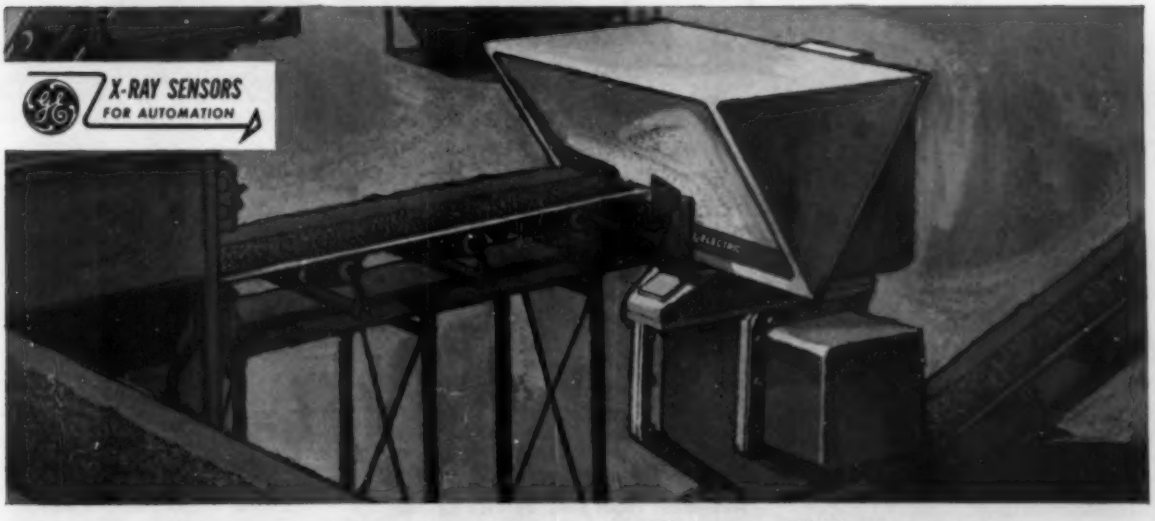


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## Texas Gulf Sulphur Studies Potash Project

Texas Gulf Sulphur Co. may diversify its single-commodity operation with a new potash project centered about a Utah deposit which the company says is the richest known in the U. S. The company has an option to buy the potash property near Moab, Utah, from the Delhi-Taylor Oil Corp. and has been conducting core-drilling evaluations which so far have cost more than a half million dollars. C. O. Stephens, company president, said Texas Gulf would invest $20 million to $30 million in construction of facilities to develop the reserves and might build a 10,000-tpd processing plant. If directors approve the plan, costs would be financed from profits obtained from sulfur operations.

## Cuban Workers Operating Nicaro Following U.S. Shutdown

The U. S. Government shut down the Nicaro nickel plant in Cuba, announcing that confiscatory taxes and harrassment by the Cuban government had forced the closure. Days after the Government announcement, it was reported from Cuba that employees were continuing operations and that Cuban militiamen had moved into the plant.

## Cerro Plans Large Peru Expansion

Cerro de Pasco Corp. approved expenditure of $6,825,000 for plant additions in Peru involving modification of two production facilities. The electrolytic zinc plant located at La Oroya is to be increased in capacity from approximately 32,000 to 52,000 tons of Special High Grade zinc a year. Estimated completion date is June 30, 1962. In addition, the concentrator at Cerro de Pasco in central Peru, where the company has its principle operating mine, is to be expanded to accommodate increased volume of copper ore and lead-zinc ore. The concentrator expansion will help reduce costs by permitting Cerro to use more open pit ores extracted by expensive underground methods. The project should be completed by the end of 1961. Cerro is shifting its extraction of copper ore at the mine at Cerro de Pasco from underground mining to open pit mining of ore of somewhat lower grade. The orebody is such that copper can be mined in large part only in combination with lead-zinc ores. The changes will not result in a substantial increase of copper output and Cerro's lead production in Peru will not be increased at present.

## Custom Smelter Copper Price Cut

Following a steady decline in prices for the red metal in London, custom smelters in the U. S. reduced the price of copper 3¢ per lb to 30¢, the first change in the domestic copper price level since March 10. Kennecott, Anaconda, and Phelps Dodge also cut their prices 3¢ from 33¢, the price they have quoted since November 12, 1959. Pressure for the similar cut by the primary producers was strong because of the price disparity, but the 10-pct output slash by Rhodesian Selection Trust companies and the strike at the Chuquicamata mine in Chile were originally considered as factors that would delay such a primary metal price reduction.

## Navy to Purchase All Military Metals

The Military Industrial Supply Agency (MISA) of the U. S. Navy will coordinate all metal purchases for the armed forces, beginning January 1, 1961. Purchases were formerly handled by five separate agencies.

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## ABSTRACTS

(Continued from page 1146)

**Plexiglas Mine Model** by *George E. Erdman*—The author describes an interesting and relatively easy method of constructing a model from plastic materials. The time and expense have been justified, since visitors and mining personnel have gained a better conception of the physical layout of a mine. **Ref.** (MINING ENGINEERING, **November 1960**) **p. 1172.**

**Successful Application of the Gravitational-Inertial Classifier**—A report on the first application in this country of a new classifier developed by Buell Engineering Co. This classifier has proved successful at the Warner Co. limestone crushing plant in Bellefonte, Pa. **Ref.** (MINING ENGINEERING, **November 1960**) **p. 1175.**

**SME Meeting Papers:** *The following abstracts of papers presented at SME meetings are given for your information. Preprints of these papers are not available.*

**IBM Processing of Mine Assay Data** by *George S. Koch, Jr.*, and *Richard F. Link*—In an investigation of the zoning and frequency distribution of gold, silver, lead, copper, and zinc in the Frisco mine, San Francisco del Oro, Chihuahua, Mexico, IBM processing proved to be an efficient means of handling some 38,000 assays of mine samples investigated for scientific purposes and is also valuable for making the calculations for mining operations.

Assay data can be processed by IBM equipment in the following ways: New assay data, vein widths, and sample locations are punched on IBM cards at a cost of about 4 cents a sample. Existing data can be punched from assay maps at a cost of about 8 cents a sample. From these data all functions such as contents (vein width multiplied by assay) are obtained by machine.

From the IBM cards, the items like the following can be obtained readily, rapidly, and without error: a) calculation of dollar value of blocks of ore, based on metal prices or liquidation values existing at a particular time; b) calculation of block limits as they shift with changing metal prices; c) calculation of ore reserves, the methods being cheap and routine enough to allow yearly reblocking of ore even in large mines producing several metals; d) tabulation of assays, and averaging of assays as commonly done for periodic mine reports.

Suitable IBM machines rent for about $600 per month and can be used for other purposes such as payroll accounting. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

**The Current Status of the Direct Reduction of Iron Ore** by *H. W. Lownie, Jr.*—In a survey of direct reduction of iron ore for those not currently engaged in the field, attention is directed to the changes in technology and economics that have prompted the present-day renewal of interest in methods for reducing iron ore without a blast furnace. Types of processes which are covered include some for making sponge iron and some for making pig irons. The reasons for interest in so-called "pretreatment" and "prereduction" steps ahead of electric smelting furnace are explained. Both 1) technical descriptions (including flowsheets and material balances for some selected processes) and 2) economics and costs are covered. The paper concludes with a presentation of the estimated cost of making pig iron, sponge iron, and steel by four typical processes that might be used in the Portland area. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

**Production of Ferronickel at Riddle, Oregon** by *Emmons Coleman* and *D. N. Vedensky*—Procedures utilized by the Hanna Mining Co. and Hanna Nickel Smelting Co. to produce ferronickel from lateritic nickel ores found near Riddle, Ore., are described. After an introduction to the location and general topography of the orebody, the open-pit mining operation is described.

Smelting procedures are covered quite completely, including drying, crushing, calcining, and smelting by the patented Ugine process. The reducing procedure, with specially built handling equipment, is described in detail, as are procedures used for removing impurities from the ferronickel. Some performance problems are covered. *AIME-ASM Pacific Northwest Metals and Minerals Conference, Portland, Ore., April 1960.*

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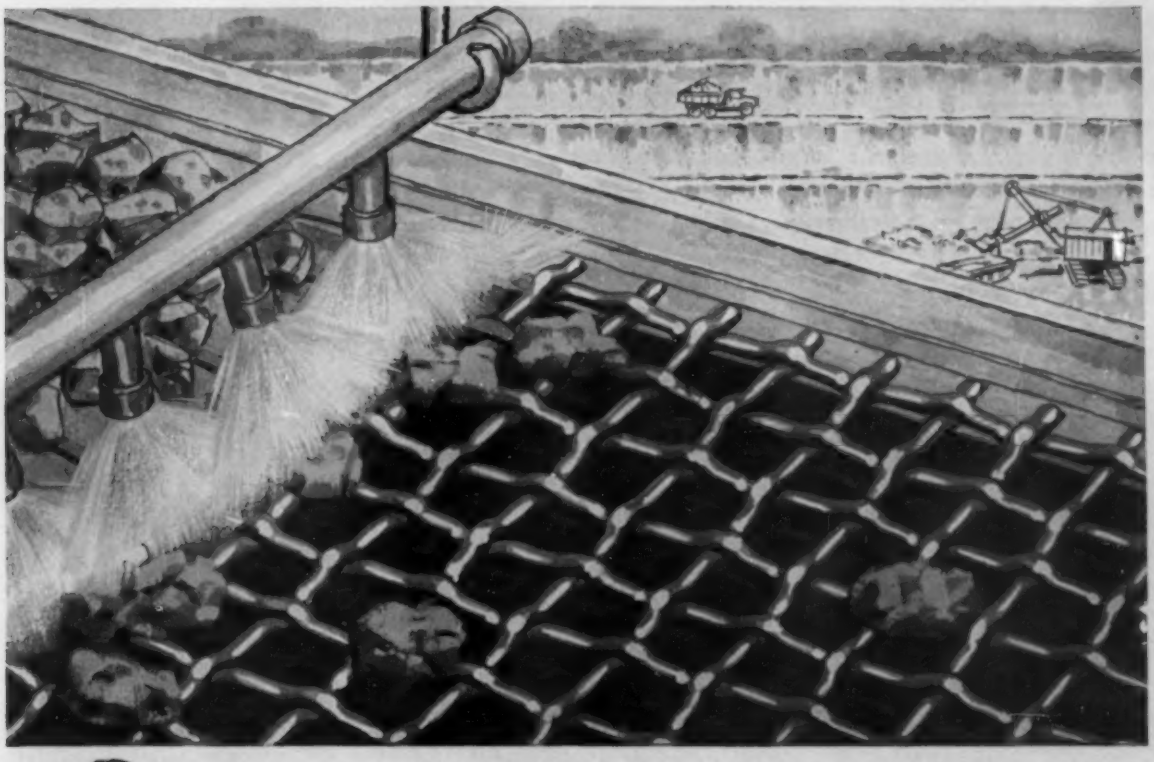

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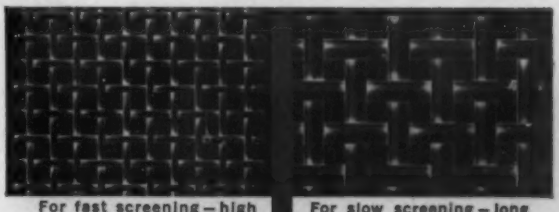

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The following list of papers (from the 1960 New York Annual Meeting) will be available until Jan. 1, 1961. Coupons received with the 1960 dues bills and those distributed at the 1960 Annual Meeting will also expire on this date. Purchased coupons books will be honored on any future date. A new listing of available papers will appear in a forthcoming issue. It will include additional papers presented at the 1960 Annual Meeting (New York) and at other SME meetings throughout the year. **Preprints may be obtained (upon presentation of properly filled out coupon) from SME Headquarters, 29 W. 39th St., New York 18, N. Y.** Coupon books may be obtained from SME for $5 a book (10 coupons) for members or $10 a book for nonmembers. Each coupon entitles the purchaser to one preprint.

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### Coal (F)

Coe, G. D., and Keller, G. E.: *Tube Furnace Method for Rapid Determination of Sulfur in Coal.* **60F40**

Corriveau, M. P., and Coll, H. F.: *Solving the Flocculation Problem.* **60F59**

Davis, D. H.: *Mechanized Tamping of Mine Haulage Roads.* **60F30**

Ellison, L. D.: *Efficient Pillar Extraction by Means of Exhaust Ventilation.* **60F33**

Kamper, O. W.: *The Exploration and Mining of Raw Materials-Production of Refractory Products-Application for the Utilization of Coal.* **60F20**

Lucas, J. R.: *A Field Study in Acid Mine Drainage.* **60F35**

Mason, J.: *Daily Maintenance and Complete Overhaul of Continuous Miners.* **60F65**

Morris, F. M.: *Moss Number 3 Mine: The Materials Handling Aspect.* **60F44**

Osmanaki, J. E.: *The Communications Challenge of Automation.* **60F104.**

Poundstone, W. N.: *Face Ventilation in Development with Continuous Miners.* **60F32**

Rao, P. D., Charmbury, H. B. and Mitchell, D. R.: *Crushing of Anthracite for the Reduction of Domestic to Steam Sizes.* **60F7**

Ridenour, D. C.: *Ventilation of Versatile Mines Making Use of Large Diameter Bore Holes.* **60F34**

Sargeant, L.: *Ventilation Considerations in Conventional Development in Gassy Coal Mines.* **60F37**

Spindler, G. R., and Pounds, E. W.: *Experimental Work in the Fragmentation of the Pittsburgh Coal Seam by Horizontal and Vertical Drilling.* **60F10.**

Stachura, J. A.: *Selecting the Proper Type of Continuous Miner.* **60F49**

Updegraff, L. A.: *Continuous and Automatic Measurement of Moisture in Coal by Capacitance.* **60F21**

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Kadey, F. [illegible]tto, F. B., Jr., and Weymouth, L. [illegible]: *Study of the Abrasive Action of Fine Powders.* **60H56**

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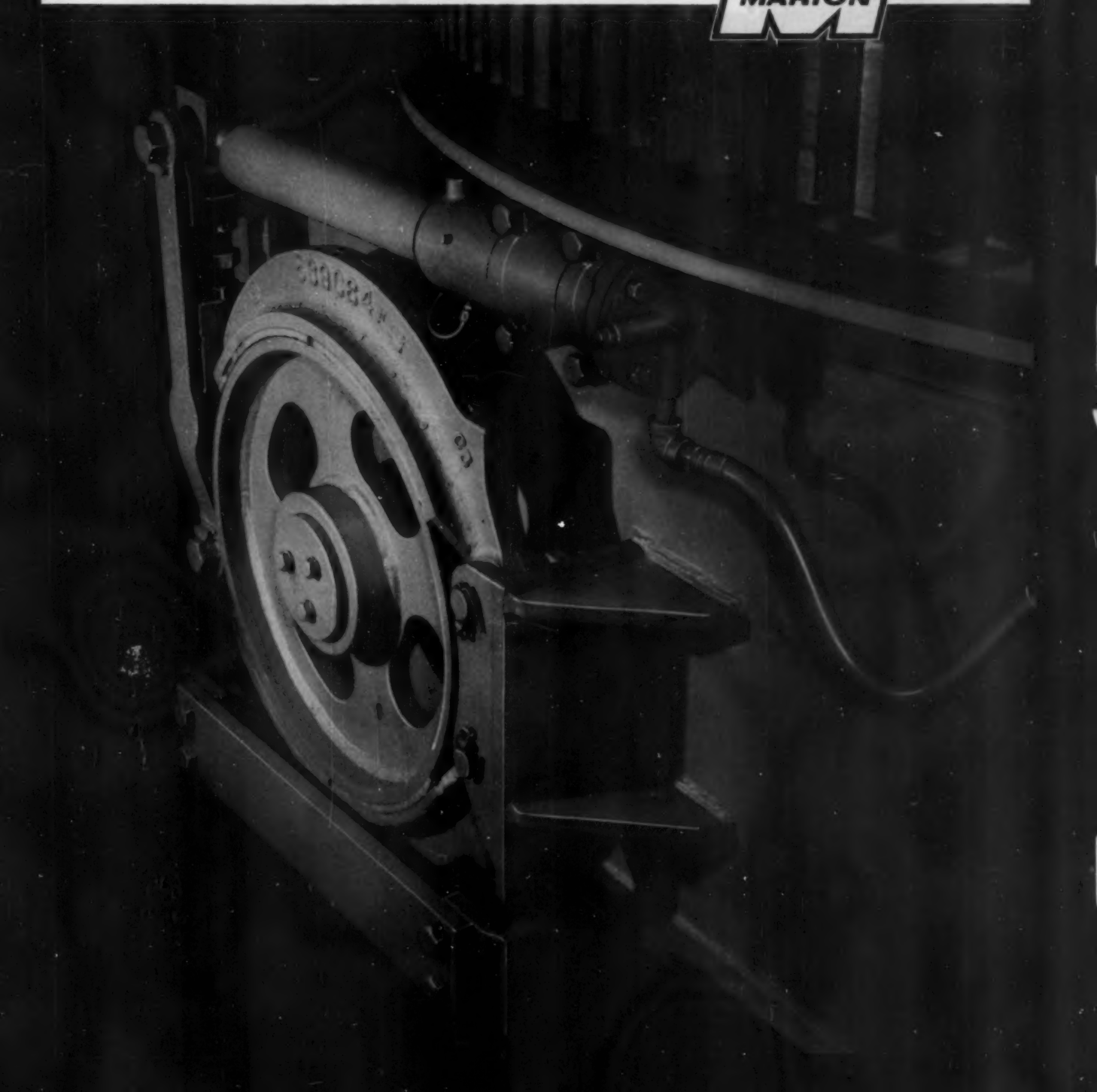

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MINING engineering **DRIFT**

## NOTE FROM A FORMER "DRIFT" WRITER

Just before Rix Beals left for the recent SME Board meeting at Denver, he suggested that I, as Secretary of the AIME Member Gifts Committee for the United Engineering Center, write a piece about the project for *Drift*. One of Webster's definitions of "drift" is "a sluggish course," and that is exactly what the course of member giving has been in the last few months —sluggish.

Only 6784 members of the Institute had made contributions up to Oct. 1. That is just a little less than a quarter of the nonstudent Institute membership. And $85,282 must still be collected to meet our $500,000 quota. The other four Founder Societies have all done better in meeting their quotas than we. But certainly AIME members have no less professional consciousness and are no less willing to accept responsibilities than other breeds of engineers. No, it is just that a lot of you haven't been asked. So I am asking you. A year from now, barring strikes (a formidable factor to bar, incidentally), we should be in our new building. And we don't want to have to put a private little AIME mortgage on it.

It was 2½ years ago that we accepted, as a part-time job to be completed within a year, this assignment of helping in the financing of the new building. We want to wind it up by Dec. 31. If we don't, we should be fired.

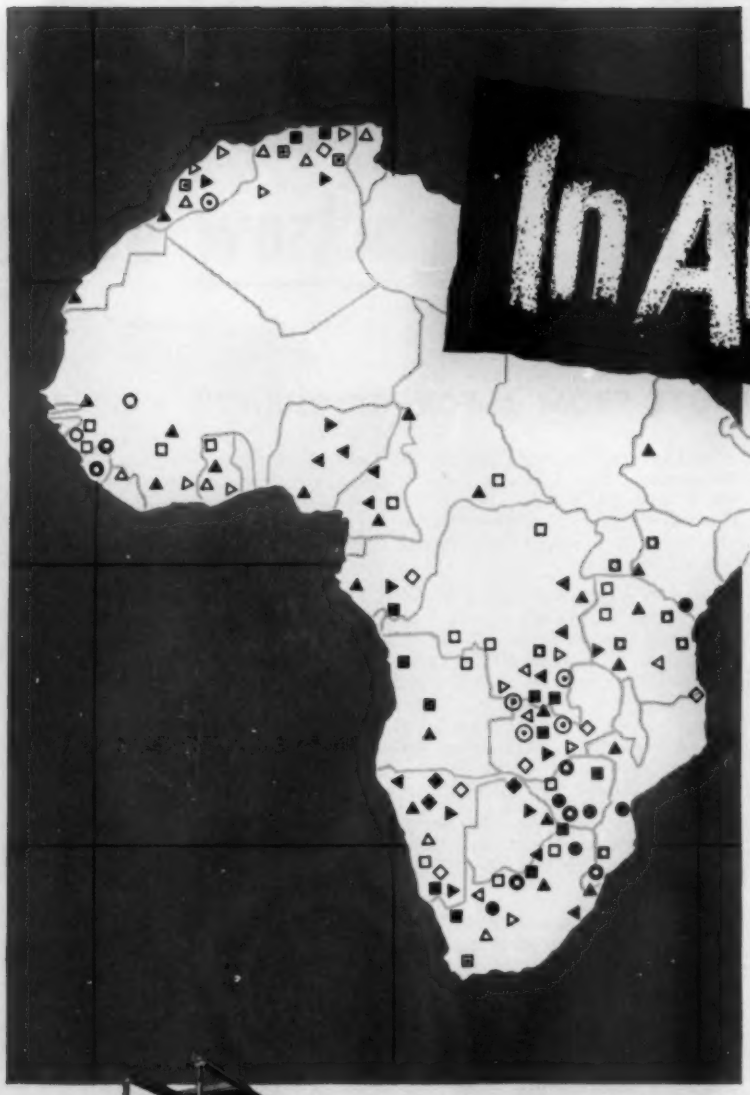
The building is something you are going to be proud of—even more proud than you are ashamed of your present headquarters. Every member of the profession is going to be better served, whether or not he comes to New York. Facing the United Nations Plaza, it will be a world-admired symbol of American engineering achievement.

Now what do you do? As soon as you read this, get out your checkbook. Fill out a check to *United Engineering Trustees* according to your means, and send it to Edward H. Robie, AIME, 29 W. 39th Street, New York 18, N. Y. (Don't make it out to me, or I might by mistake put it in my own private bank account, thinking you were at last paying up some old debt that I had forgotten about). But suppose you have no money in the bank. In that case just write me a letter saying you want to be among the elect, even if not among the elected, and that you will pay so much on such a date, so much more on such and such a date, and wind up the matter on still another date, any time within three years. Surely you don't always expect to be broke.

And what tangible thing do you get out of it? Here is the always necessary "amazing offer." All gifts or pledges of $25 or more will receive a special Christmas card from us. And to those who give or pledge $50 or more we will also put the name of the giver or pledger on a list to receive, when and if published, a copy of a little booklet we have been urged to prepare, containing selected items from the nonsense that we used to write for "The Drift of Things" in MINING AND METALLURGY. *Edward H. Robie*

## . . . . BUT WE MEANT WELL

The readers of *Drift* in the October issue may have noticed a "slight" error in "Roundup at Las Vegas." In calling your attention to the Mining Show recently sponsored by the American Mining Congress, we inadvertently referred to it as "AIME Mining Show"; we meant, of course, "AMC Mining Show". In acknowledging the editorial oversight, we also take the opportunity to congratulate AMC on the success of their undertaking. It was an affair of which they may be justly proud. A review of the show is found on page 1179.

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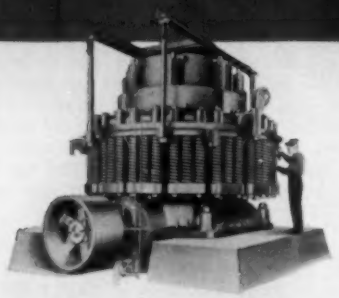

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# MAGNETIC ROASTING OF IRON ORES IN A TRAVELING GRATE ROASTER

*An experimental traveling grate roaster has been built and operated by the University of Minnesota. This article reports the results of tests conducted on low-grade iron ores in an effort to develop such a roaster for large-scale commercial operations.*

H. H. WADE and N. F. SCHULZ

The large quantities of iron-bearing materials, including taconite, semi-taconite,* and other low-grade ferruginous materials occurring in Minnesota and elsewhere, constitute an important potential source of iron. Satisfactory grade and recovery of iron ore concentrate cannot ordinarily be obtained from these ferruginous materials by simple methods of beneficiation.

Iron is distinctive in that the free metal and two of its oxides [magnetite ($Fe_3O_4$) and maghemite (gamma-$Fe_2O_3$)] are strongly ferromagnetic. The successful magnetic separation of natural magnetite from taconite has already been established on a commercial scale. The iron in semi-taconite, however, occurs largely as goethite ($Fe_2O_3 \cdot H_2O$) and hematite ($Fe_2O_3$) which do not respond to ordinary magnetic separation methods. Magnetic roasting converts these iron oxides to magnetite, which can, after liberation, be magnetically concentrated.

## MAGNETIC ROASTING

Hematite undergoes a stepwise reduction when exposed at moderately elevated temperatures to a reducing atmosphere containing hydrogen or carbon monoxide:

$$Fe_2O_3 \rightarrow Fe_3O_4 \rightarrow FeO \rightarrow Fe$$

Since the desirable product in magnetic roasting is $Fe_3O_4$, the conversion is halted after the first stage by controlling the reduction potential of the gas mixture with water vapor or carbon dioxide. The reducing gas mixture must be such that the oxygen partial pressure at the solid-gas reaction interface will be maintained intermediately between the oxygen partial pressures in equilibrium with $Fe_2O_3$ and $Fe_3O_4$ at the prevailing temperature. Because of the rapid increase in decomposition pressure of $Fe_3O_4$ with increase in temperature, the practical upper limit of useful reaction temperature is about 1400°F, above which over-reduction usually occurs in atmospheres containing hydrogen or carbon monoxide. On the other hand, useful reaction rates usually occur only above 800°F.

Goethite reacts similarly except that the combined water probably has to be driven off thermally before the reduction to magnetite occurs. Iron carbonate must also be decomposed thermally to an oxide before conversion to magnetite. Iron silicates are apparently not amenable to magnetic roasting.

The rate of penetration of the reaction toward the interior of a given ore fragment is dependent on the chemical composition and physical structure of the solid. Most ore fragments tested here reduced satisfactorily to ¼-in. depth in less than 14 min at 1200°F. Some very dense fragments, however, were reduced to less than 1/32-in. depth under the same conditions.

Determination of the optimum temperature, gas composition, ore fragment size, or time of exposure

H. H. WADE is Director of the Mines Experiment Station, and N. F. SCHULZ is a Research Associate at the Mines Experiment Station, University of Minnesota, Minneapolis, Minn.

* State Laws of Minnesota, (1959), Chap. 81, H.F., 26, Sec. 1, Subd. 1: "For the purposes of this act, 'semi-taconite' is defined as altered iron formation, altered taconite, ferruginous chert or ferruginous slate which has been oxidized and partially leached and in which the iron oxide is so finely disseminated that substantially all of the iron-bearing particles of merchantable grade are smaller than 20 mesh and which is not merchantable as iron ore in its natural state, and which cannot be made merchantable by simple methods of beneficiation involving only crushing, screening, washing, jigging, heavy media separation, spirals, cyclones, drying or any combination thereof."

is beyond the scope of this investigation. The primary object was to devise a practical scheme applicable to large-scale continuous magnetic roasting of low-grade iron ores, and, secondly, to roast tonnage samples of various ores for subsequent magnetic separation studies.

## HORIZONTAL TRAVELING GRATE

An apparatus for roasting iron ore must be equipped to heat the ore to a specified temperature, dispose of any volatile decomposition products, expose the heated ore to the action of a reducing agent until satisfactory conversion of iron minerals to magnetite is accomplished, and discharge the roasted product under useful and stable conditions. Auxiliary means must ordinarily be provided to supply the process heat and the reducing agent.

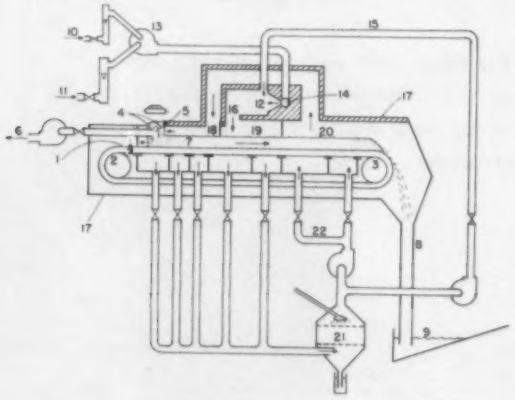


*Fig. 1—Traveling Grate Roaster, Scheme I.*

Types of apparatus which can be adapted to iron ore roasting include 1) the vertical shaft furnace, 2) the rotary kiln, 3) the multiple hearth furnace, 4) the fluidized solids reactor, and 5) the horizontal traveling grate.

An experimental traveling grate roaster has been constructed and successfully operated at the Mines Experiment Station of the University of Minnesota. It is, essentially, an apparatus in which the iron ore, properly prepared by comminution and agglomeration, forms a continuous gas-permeable bed of uniform cross section which is carried through a series of treatment zones on an endless heat-resistant permeable conveyor. Gas mixtures of controlled temperature and composition are forced vertically through the ore bed, successively drying, heating, reducing, and cooling the ore in a continuous process. A combustion chamber, which is fed a mixture of air and natural gas and which supplies both heat and the reducing gas mixture, is an integral part of the apparatus. Auxiliary equipment includes a gas cooler, gas blowers and ducts, ore preparation and handling equipment, and instrumentation and control devices.

**Scheme I:** A schematic diagram of the experimental horizontal traveling grate roaster, employing updraft product cooling, is shown in Fig. 1. The grate (*1*) consists of cast iron-alloy tuyere blocks, each 10 in. long, placed four abreast on an endless link-and-bar chain. This grate assembly slides along horizontal support bars between an idler sprocket wheel (*2*) and a driven sprocket wheel (*3*) whose centers are 16.8 ft apart. Side walls, 8 in. high, attached to the outer tuyere blocks limit the ore bed to a cross section 24 in. wide by 8 in. deep. The blocks have two horizontal gratings, the 3-in. spaces between which are loosely filled with ¾-in. steel balls serving as a heat reservoir. A single-horizon grate without attached side walls, together with a 4½-in. hearth layer of previously roasted product, served similarly in earlier tests.

The unsized crushed ore, balled in a 5½ ft diam balling disc, is fed to the grate (*1*) by gravity flow through a pair of feed slots (*4*) extending across the grate and separated by a slotted gas exhaust manifold (*5*). The exhaust gas (*6*) passes through the two 4-in. ribbons of wet feed as they move through the feed slots and gives up enough thermal energy to the ore to prevent objectionable moisture condensation in the lower part of the 8-in. ore bed (*7*) during the drying operation on the grate; excessive moisture condensation tends to weaken the wet balls and to cause the bed to collapse. This exhaust system also serves to prevent the air trapped in the feed from getting into the system.

The roasted product is discharged from the end of the grate through a gas-tight chute (*8*) which extends below the surface of the water pool of a spiral classifier (*9*), thus avoiding contact of warm freshly-roasted product with the surrounding air until it has been thoroughly drenched. Alternatively, the roasted product can be recovered dry at less than 150°F if desired. In any case, influx of air through the product discharge must be prevented.

Process heat and gaseous reactants are produced simultaneously by combustion of natural gas (*10*) with limited air (*11*) in the cast refractory combustion chamber (*12*). Gas and air are premixed in a proportioning gas mixer (*13*) and fed to the com-

**Table I. Iron Ores Tested**

| | Ore Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H |
| Crushed to: (in.) | −½ | −½ | −⅜ | −⅜ | −⅜ | −⅜ | −⅜ | −⅜ |
| Size: Cum. pct on: | | | | | | | | |
| (Tyler Std) 4 mesh | 30.8 | 36.9 | 31.3 | 34.6 | 38.3 | 12.5 | 18.7 | 17.7 |
| 14 mesh | 50.0 | 53.7 | 47.3 | 63.1 | 72.9 | 51.1 | 44.2 | 42.4 |
| 48 mesh | 61.9 | 67.2 | 69.5 | 71.6 | 87.1 | 86.4 | 58.7 | 63.3 |
| 200 mesh | 72.7 | 77.0 | 78.8 | 79.7 | 92.5 | 90.8 | 70.9 | 70.7 |
| Composition: | | | | | | | | |
| Pct Fe | 35 | 39 | 38 | 38 | 28 | 45 | 32 | 29 |
| Pct Fe++ | 0.6 | 1.7 | 1.5 | 0.8 | | 1.7 | 0.6 | |
| Pct Mn | | | | | 10.7 | | | 1.5 |
| Pct $Al_2O_3$ | | | | | | 13.1 | | |
| Pct $SiO_2$ | | | | | | 13.8 | | 42.3 |
| Pct ignition loss, (1800°F) | 4.3 | | | | | 8.7 | 4.1 | |
| Pct Fe in −200 mesh | 17.2 | 17.6 | | 46.1 | 29.4 | 30.2 | 12.8 | 17.6 |
| Mean specific gravity | 3.1 | | | | | 3.6 | 3.1 | 3.0 |
| Moisture in feed after agglomeration, pct | 10.9 | 10.0 | 9.2 | | | 12.9 | 9.5 | 11.0 |

**Table II. Natural Gas Composition*, 1000 BTU/SCF, Gross**

| Constituent | Pct |
|---|---|
| $CH_4$ | 72.0 |
| $C_2H_6$ | 15.6 |
| $CO_2$ | 0.1 |
| $O_2$ | 0.1 |
| $N_2$ | 12.2 |

* Minneapolis Gas Co.

**Table III. Approximate Gas Flow Rates (Measured At 70°F, 1 Atm., Tests on Ore F)**

| | Drying Section | Reaction Section | Cooling Section (Updraft) |
|---|---|---|---|
| Effective grate area, sq ft | 8 | 8 | 5 |
| Total gas flow, cfm | 1130 | 490 | 1100 |
| Mean linear gas velocity, fpm | 144 | 61 | 220 |
| Pressure drop per ft of depth, in. water column | 2.9 | 2.2 | 6.1 |

bustion chamber through a drilled-port pipe manifold (*14*). Recycled spent gas (*15*) is introduced near the exit of the combustion chamber where it mixes with the fresh combustion products to form a reaction gas mixture (*16*) at the desired degree of temperature.

The entire grate assembly and combustion chamber are encased in a gas-tight sheet metal housing (*17*), insulated where necessary, to isolate the process from the surrounding air. All blower shafts and valve actuating stems are sealed against possible air influx.

The gas spaces above and below the grate are divided into compartments so that the various gas streams can be properly directed through the ore bed. Because of the difficulty in providing adequate gas seals between compartments above a moving bed of ore, pressures in these upper compartments are held approximately equal and slightly above atmospheric pressure.

Control valves, flowmeters, thermocouples, and pressure and gas sampling taps, installed at strategic points, facilitate operation of the apparatus as an experimental unit. A continuous calorimeter-type of gas combustibles analyzer and recorder indicates the combustibles content of the reaction and spent gas streams. The gas burner is equipped with automatic safety pilot and cut-off valves.

In operation, the ore is first carried by the grate through the drying section (*18*) where it is dried and partially heated by downward flow of hot gas coming from the product cooling section (*20*). It is next carried through the reaction section (*19*) in which the reaction gas mixture at a specified temperature and composition is passed down through the ore bed to heat the solids to reaction temperature and at the same time provide the reducing atmosphere required to convert the iron minerals to magnetite. The roasted product is cooled in the product cooling section by an updraft stream of cooled and dehumidified spent gas and discharged into the spiral classifier (*9*).

The relatively cool, moist gas emerging below the ore bed in the drying section is combined with the hot spent gas from the reaction section and cooled with water in a short coke-packed tower (*21*). The cooled gas is then reused as tempering gas in the reaction section and as coolant (*22*) in the product cooling section.

In the case of the gas flow of scheme I, (Fig. I) the heat wave produced in the reaction section is pushed into, but not through, the heat reservoir and then back and out of the top of the ore bed. The grate chain is thus never exposed to temperatures above 800°F. With minimum exposure time to reaction conditions at the bottom of the ore bed, the ore near the top is held unnecessarily long at reaction conditions. However, this scheme imposes minimum requirements on materials of construction, and all required gas movements in the system are adequately accomplished by blowers operating at ordinary temperatures.

**Scheme II:** A similar scheme in which downdraft gas-flow through the ore bed is maintained throughout the process is shown in Fig. 2. Since the heat wave is here pushed completely through the ore bed and its support, the grate chain must withstand temperatures up to that of the reaction, and the heat reservoir is no longer of any use. To maintain equal pressures in the upper gas compartments, a high temperature (800°F or more) blower (*23*) is provided to draw the cooling gas (*22*) through the hot roasted product. Scheme II has the advantage over scheme I in that the heat and reaction wave in the ore bed, once well established, can be pushed through the rest of the way by the cool reactive gas in the product cooling section. Thus, no part of the bed is exposed longer than necessary to reaction conditions, and the rate of production per unit of grate area is increased by the effective overlapping of the reaction and cooling sections.

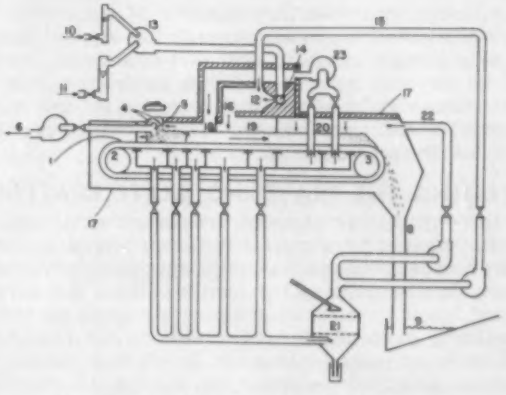


*Fig. 2—Traveling Grate Roaster, Scheme II.*

The processes occurring in the reaction section are complex and interdependent. First of all, there is the matter of heat transfer from a hot gas to the solids of a packed bed. The temperature profile of the heat front progressing through the ore bed is dependent on heat transfer rates which are functions of gas velocities, heat transfer areas, and thermal properties of both solid and gas. The rate of movement of this heat front is directly proportional to sensible heat accumulation in the bed, that is, to the superficial gas velocity. In relatively shallow beds, as in this instance, the shape of the heat front probably does not become stabilized and thus the propagation rate of the isotherm corresponding to a usable reaction temperature is also probably not constant.

Since the mechanisms of reactions between reducing gases and ore which result in the formation of magnetite are unknown, the progress of the line of completed conversion, which much necessarily lag some distance behind a certain minimum isotherm, can best be determined empirically in specifically designed experimental apparatus other than the present traveling grate.

**Scheme III**: Where the rate of heat transfer is the controlling process, increased gas velocities through the bed can materially decrease the required residence time of the ore in the reaction and product cooling sections. A proposed third scheme which takes advantage of this fact is shown in Fig. 3. A second hot gas blower (*24*) recycles hot spent gas (*25*) from the reaction section directly back of the

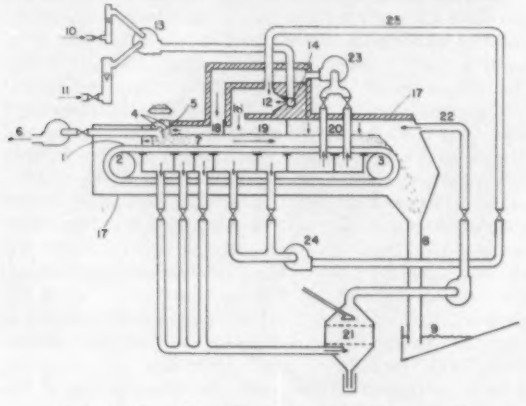



*Fig. 3—Traveling Grate Roaster, Scheme III.*

combustion chamber. The quantity of hot reaction gas available for passage through the ore bed thus will be greatly increased over that of schemes I and II for the same input rate of fresh combustion products. This should substantially increase the production of roasted ore per unit grate area at an increased thermal efficiency.

## TESTING THE TRAVELING GRATE ROASTER

Proving the operation of the experimental horizontal traveling grate roaster is complicated by the fact that performance is largely dependent on widely variable properties of the raw ore. Thus, the composition and physical structure of any given ore will dictate a particular set of conditions for roasting which is optimum for that ore. In addition, the particular details of treatment during the subsequent magnetic procedures may also have some effect on the exact position of this optimum when considering the overall process. On the other hand, considerable latitude in roasting conditions is available in the traveling grate roaster, so any overall metallurgical test from raw ore to iron ore concentrate, through roasting and magnetic separation, is more a test of the ore than of the traveling grate roaster.

In view of this, and the present lack of knowledge concerning optimum operating conditions of both the roasting process and the magnetic separation procedures, large-scale tests were not stressed in the test work. Instead, many tests were made on a few typical raw materials, in which operating conditions were investigated and the quality of products obtained was determined by assays and magnetic tube tests on selected samples of product. Most tests were conducted according to flow scheme I in which the direction of gas flow through the ore bed was reversed between the reaction and product cooling sections.

Preparation of the ore for roasting was standardized by crushing it to $-\frac{3}{8}$ in. and agglomerating it into ¼ to ½-in. balls with water as binder. The free moisture in the agglomerated ore was usually about 10 pct (wet basis) for an ore containing 40 pct Fe, which corresponds to about 30 pct water on a volume basis in the balls. Small variations in moisture greatly influenced the size of the balls formed, that is, the greater the moisture the larger the balls. The resistance to air flow in the bed on the grate was only slightly affected by ball size because of the attenuating effect of the feeding mechanism as the ore was "pulled" from the bottom of the feed slots by the slowly moving grate. The drier feed of smaller balls was, therefore, usually preferred because less heat was needed to dry it. Ore bed bulk density was usually between 90 and 110 lbs of dry ore per cu ft, and the bed permeability was such that the passage of air at 70°F and 1 atm and 100 fpm superficial velocity developed a pressure drop of about 1-in. water column per ft of bed depth for reasonably well-agglomerated ore.

## EXPERIMENTAL RESULTS

The ores listed in Table I were balled and used in traveling grate roaster tests. The reducing gas mixtures and process heat were obtained by burning natural gas (Table II) at 80 to 85 pct aeration and mixing the combustion products with cooled recycled spent gas. These mixtures contained up to 10 pct total CO plus $H_2$ (dry basis) at CO:$H_2$ ratios between 0.5 and 1.0, and were readily maintained at any temperature up to 1500°F. A typical set of gas flow rate data is given in Table III.

Illustrative data on the quality of roasted product obtained under specified roasting conditions are given in Table IV. Ores *A* thru *D* (Table I) were roasted in the apparatus with stationary side walls; ores *E* through *H*, after installation of the moving side walls. The use of moving side walls greatly diminished the wall effects on gas flow by eliminating the deep side wall troughs in the ore bed. Reaction temperatures were assumed to be identical with the gas temperatures as measured by a high-velocity thermocouple above the ore bed in the reaction section. The gas drawn through this device was passed continuously through the combustibles analyzer.

Roasted product quality was estimated by means of standard Davis tube magnetic separation tests at −150 mesh and by appropriate chemical assays performed on grab samples of the roasted ore. These samples were taken at the center line of the ore bed at three levels: *T*, top two in.; *M*, middle two in.; and *B*, bottom two in. Most of the data represent mean values from a number of arbitrary samples. It is apparent, however, that the relationship between tube test results and ferrous-to-total iron assay ratios of the roasted products is dependent on the properties of the ore. As expected, with updraft cooling following downdraft reaction, data for ores *D*, *F*, and *G* all show that the upper part of the ore bed was roasted more thoroughly than the lower part.

Similar tests of quality were performed on the separated size fractions of spiral classifier sands obtained from *G* after roasting under the conditions given for this ore in Table IV. The results are il-

Table IV. Results of Magnetic Roasting on Traveling Grate

| Ore | Dry Ore Feed, lb per hr* | Ore Bed, in. | | Temp, °F | Gas, (dry) Pct ($CO + H_2$) | Sample | Roasted Product | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Depth | Width | | | | Total Pct Fe | (Fe⁺⁺/Fe) | Concentrate, Pct Fe | Fe Recovery, Pct |
| A | 1350 | 6 | 28 | 1250 | 5.6 | T | 36.5 | 0.307 | 65.2 | 84.7 |
| D | 1160 | 6 | 28 | 1250 | 6.3 | T | 39.2 | 0.286 | 65.8 | 96.0 |
| | | | | | | B | 38.4 | 0.152 | 67.8 | 79.2 |
| F | 1000 | 8 | 24 | 1350 | 5.3 | T | 51.0 | 0.324 | 63.8 | 68.7 |
| | | | | | | M | 51.2 | 0.324 | 63.6 | 67.5 |
| | | | | | | B | 50.4 | 0.281 | 63.4 | 61.3 |
| G | 880 | 8 | 24 | 1310 | 6.9 | T | 36.4 | 0.258 | 65.7 | 96.9 |
| | | | | | | M | 34.9 | 0.263 | 65.2 | 95.7 |
| | | | | | | B | 33.5 | 0.252 | 65.6 | 96.2 |
| H | 1000 | 8 | 24 | 1300 | 8.0 | T | 32.0 | 0.290 | 62.1 | 85.0 |

* 1000 lb per hr is equivalent to about 0.4 gross ton per day per sq ft of active grate area.

lustrated in Fig. 4. The mean values for concentrate grade and iron unit recovery agree well with those obtained from the grab samples for ore G, differences being attributable to the manner of sampling and to normal variations in the crude ore. The lower iron unit recovery from the coarser fractions was probably due to incomplete reduction of large ore fragments; that from the finer fractions, to ore structure peculiarities and possible sample deterioration. The concentrate grade was relatively constant for all size fractions.

Data from magnetic separation tests in pilot scale equipment usually agreed well with Davis tube results but were not valid tests of the roasting process because the pilot scale procedures have not yet been fully developed for use on artificial magnetite.

## CONCLUSIONS

Operation of the experimental traveling grate roaster on several ores has shown that this apparatus can readily produce the conditions of temperature, time, and reducing atmosphere required for continuous magnetic roasting of iron ores. The apparatus is also applicable to the pre-leach roasting of certain manganiferous ores because the roasting conditions can be controlled within very narrow limits. Most crude ores, when crushed to −½ in. or less, can be balled and roasted without further preparation. Dust handling problems are negligible since the ore fines are tightly bound in the balled feed.

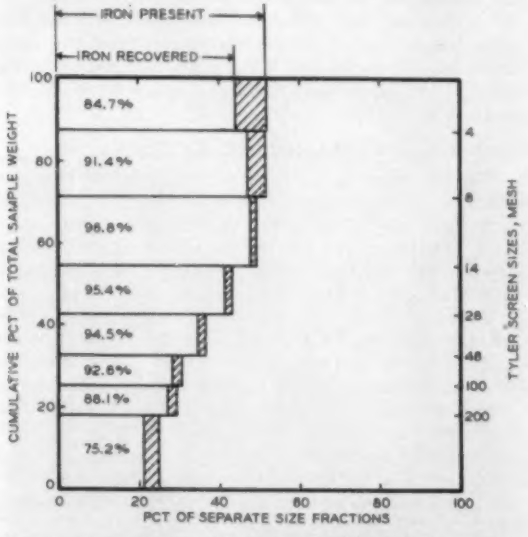



*Fig. 4—Iron recoveries from separate size fractions of ore G, roaster at 1300°F, by Davis Tube magnetic separation at —150 mesh. Total recovered concentrate: 66.6 pct Fe, 91.1 pct Fe recovery.*

Although the heat and reactant gases are produced in one simple step from natural gas in this experimental apparatus, any carbonaceous fuel, whether solid, liquid, or gas, could be similarly converted in a suitably designed combustion chamber. Additional gaseous constituents can be added directly to the reaction gas mixture as needed. Further modifications might utilize certain catalytic agents or solid reductants in the ore bed. The amount of fuel required to supply thermal energy and chemical reactants in this process will probably be in the range of 600,000 to 900,000 net BTU per gross ton of dry ore feed.

The production capacity of the experimental apparatus has not been a primary object of this investigation. However, the nominal rate of 0.4 gross tpd per sq ft of active grate area achieved under the least favorable scheme for gas flow (scheme I) is probably less than 25 pct of the rate to be expected under scheme III in this experimental apparatus. Further improvement may also be realized by adjusting the proportions of the active grate area devoted to the basic operations of drying, heating, reaction, and product cooling. It is, therefore, reasonable to expect the production rate in a well-constructed commercial machine to exceed two gross tpd per sq ft of grate area.

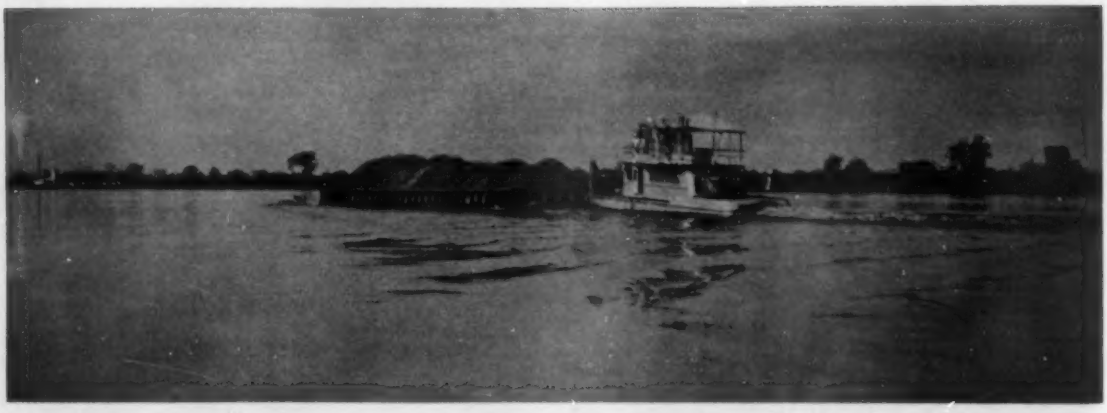
Reliable cost data are not available at this stage of the investigation. However, preliminary calculations indicate that the capital cost of equipment, at current prices, for converting crushed ore to roasted product on a commercial scale in a traveling grate roaster will be about $1.00 to $1.50 per annual gross ton of ore capacity. This process is particularly well suited for automation and operating labor costs can be minimized. Other operating costs, such as fuel and power, are expected to be reasonable.

The magnetic roasting of iron ore on the horizontal traveling grate appears to be technically and economically feasible.

## ACKNOWLEDGMENT

This traveling grate roasting process was developed as a normal function of the Mines Experiment Station of the University of Minnesota. The project was supported in large measure by funds provided by the Iron Range Resources and Rehabilitation Commission of Minnesota.

*FROM PIT TO PLANT . . . .*



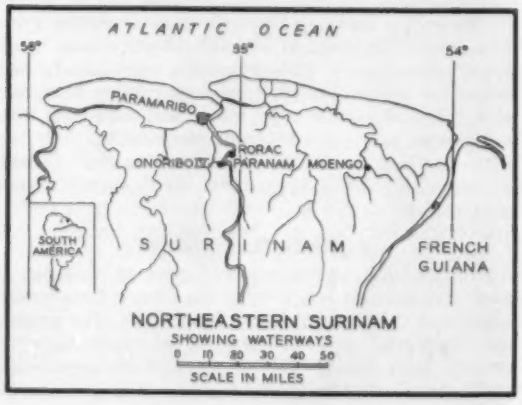
# SURALCO'S BAUXITE HANDLING SYSTEM

J. G. CAZORT, JR. and J. J. DE WITTE

The Paranam plant in Surinam (formerly Dutch Guiana) was built during 1939-40 to supply crushed and dried bauxite for the growing U.S. aluminum industry, supplementing production from the Suriname Aluminum Co.'s Moengo works, which began operation in 1922. A subsidiary of Aluminum Company of America, Suralco's total annual production from these two plants averages 2.55 million dry metric tons of various grades of bauxite.

Starting in 1941 with bauxite from mines on the west side of the Suriname River, annual production at the Paranam plant has varied from a low of approximately 450,000 tons to more than 1 million tons in 1949. High production rates during World War II and the late 1940's rapidly depleted these reserves, and in 1950 plans were made to mine the known deposits on the east bank of the river, about five miles downstream from the original Paranam plant.

These deposits occur as low hills surrounded by swamps. One deposit extends to the Suriname River. Because soil conditions in the surrounding area were poor, it was necessary to retain the drying, storage, and shiploading facilities in their original location at Paranam and provide a transportation system from the mines to the plant.




Various schemes to transport run-of-mine bauxite to the plant by railroad cars and car ferry or trucks and truck ferry were discarded in favor of a system that would handle crushed and washed bauxite at the mine site. This could have been transported via aerial tramway, pumped as a slurry, hauled by rail or truck and ferried, or carried by cargo barge. Cost estimates indicated the most economical procedure would be a crushing and washing plant at Rorac on the east bank of the river at the edge of one of the orebodies, and transport the plant product via cargo barges to an unloading station near the drying kilns at Paranam. This plan utilized existing mining, crushing, and washing machinery to the greatest advantage.

## ORE-HANDLING SYSTEM

The ore is mined from one or more of the deposits at Rorac to give the desired average grade. Stripping is handled by bulldozers, shovels or draglines, depending on the amount and nature of the overburden material to be handled. The haulage trucks, 15 and 22-ton Euclids, are loaded by combinations of 1 and 1½-cu yd shovels, 2-cu yd shovels and draglines, and a 4-cu yd dragline, depending on which deposit is being mined. The truck haulage distance varies from an average of 3000 ft in the closest deposit to a little more than 2½ miles for the longest haul.

Much of the bauxite from these deposits contains a high amount of iron and is not suitable for shipment unless beneficiated. A heavy media separation

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plant has been added to the Rorac crushing and washing plant to treat this high iron material to obtain a suitable shipping grade. The high iron and regular ore are hauled by truck to the washing plant, where the trucks dump into a hopper or onto a stockpile which can be reclaimed to the dump hopper. The dump hopper is discharged by a 60-in. heavy-duty feeder onto a 54-in. belt, which elevates the bauxite to the crushing plant.

The 54-in. belt conveyor discharges run-of-mine material onto a two-deck, heavy-duty scalping screen, oversize from the screen dropping directly into a 5050 hammermill and the 2-in. undersize going to scrubbers and dewatering screens. Up to 800 gal of water per ton are used to remove the clay and high-silica fines in the ore from the scalping and scrubbing screens. The ore passing through the crusher is not washed or screened, as the massive ore is of satisfactory grade without requiring further beneficiation.

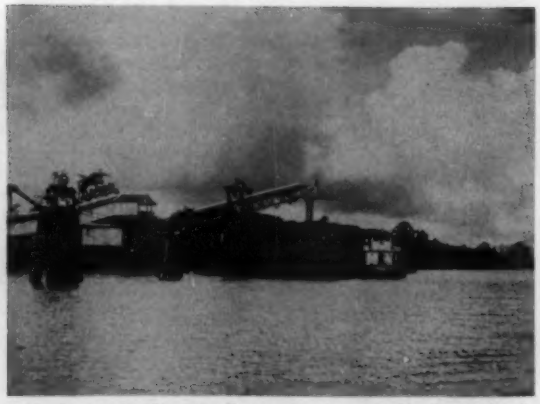
Direct shipping ore from the crushing and washing plant is carried to barges by a 30-in. belt conveyor. The high iron bauxite requiring further treatment is conveyed to a stockpile feeding the heavy media plant. The shipping-grade product of the heavy media plant is discharged to the same 30-in. belt conveying it to the barges. The barges are the surge bins for the crushing and washing operation. The reject of the heavy media plant is stockpiled for special loading via clamshell to the 30-in. barge-loading belt. Reject material is used as road surfacing material around the plants.

The barge-positioning system consists of a small dock supporting the conveyor belt boom and the barge-moving winches, and a series of dolphins. The two end dolphins are of heavy construction to resist the pull of the barge-moving winches. The barge-loading boom can be raised and lowered to compensate for an average tide range of 8 ft. The end of the boom is equipped with a trimming spout which can be moved in a vertical plane across the beam of the barge for even distribution of material. The barges are moved by a double-winch and sheave system, the winches opposing each other in normal operations to maintain a taut line. To assist the winches in holding the barges to the face of the dock, a stationary taut breast-line extends between the two end dolphins. The endless winch line is secured to the barge near the center and two bridle lines are attached to pulleys which ride the taut breast-line, one at each end of the barge, to keep it flush against the dock. The winches are driven by 20-hp electric motors, and the line speed can be varied up to 20 fpm, the speed used to position empty barges. This elaborate barge-moving installation is required to insure uniform loading. Not only are tidal currents superimposed on river currents, but near the docks, eddies are formed which change direction and velocity frequently.

Although four barges were purchased, three can handle the 300-tph capacity of the washing plant. The barges are 160 ft long and 36 ft wide, with a molded depth of 10 ft and a loaded draft of 9 ft, giving them a carrying capacity of 1000 metric tons. The barges are of the deck cargo type, having a cargo box 120 ft long, 32 ft wide, and 4 ft deep. The cargo box coaming is topped by 60-lb railroad rail for protection. Each barge has a longitudinal bulkhead between collision bulkheads and two transverse bulkheads, making a total of eight watertight compartments in the hull, with gasketed hatches to provide access for inspection and repair. Since deck plates are ¾-in. thick, operators of the unloading crane can scrape the decks and, if necessary, use small bulldozers for additional clean-up.

Barges are lashed to a pusher-type tug 55 ft long with 15-ft beam and 4-ft draft, and guided along the five-mile trip to the unloading dock. This trip

*View of the open pit bauxite mining operations at Rorac. This is one of several pits mined by Suralco in this area.*



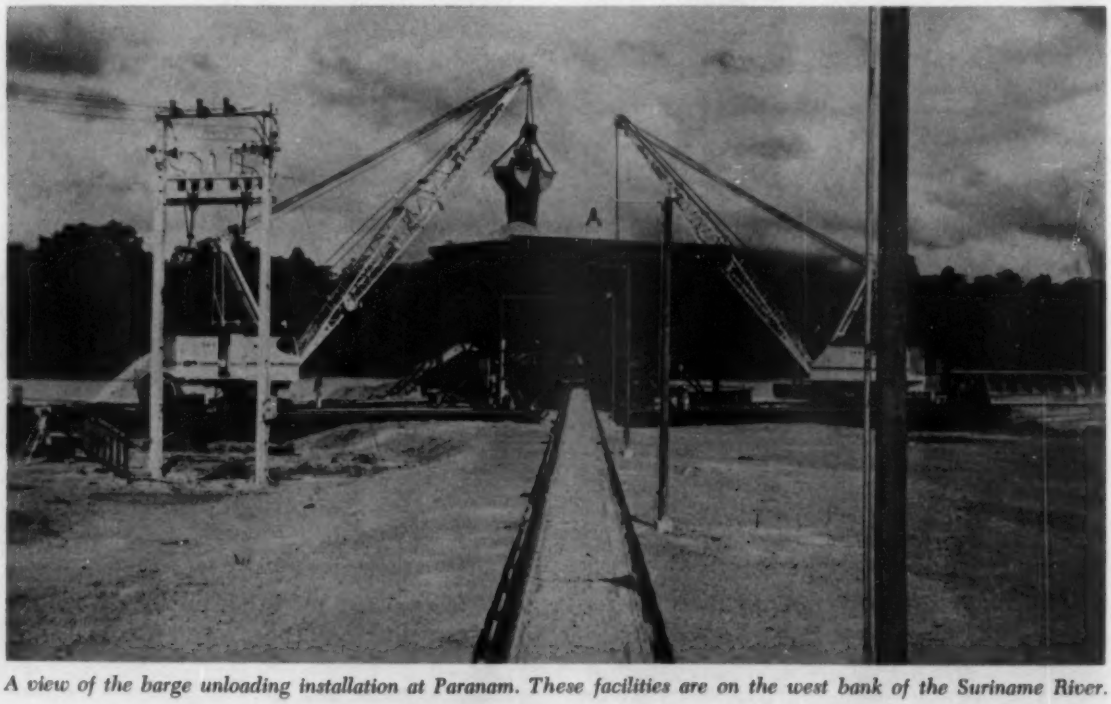
*Left, barge loading facilities on the east bank of the Suriname River at Rorac. Right, close-up of the working head of the loading conveyor. Note the movable chute which is used for distributing the bauxite evenly on the barge.*

averages 70 min and the empty barge return trip about 45 min. The tug is equipped with two 265-hp Caterpillar diesel engines swinging 48-in. diam propellers through 3:1 reduction and reverse gears. Clutches are air-operated so that one man can control the tug from the elevated pilot house.

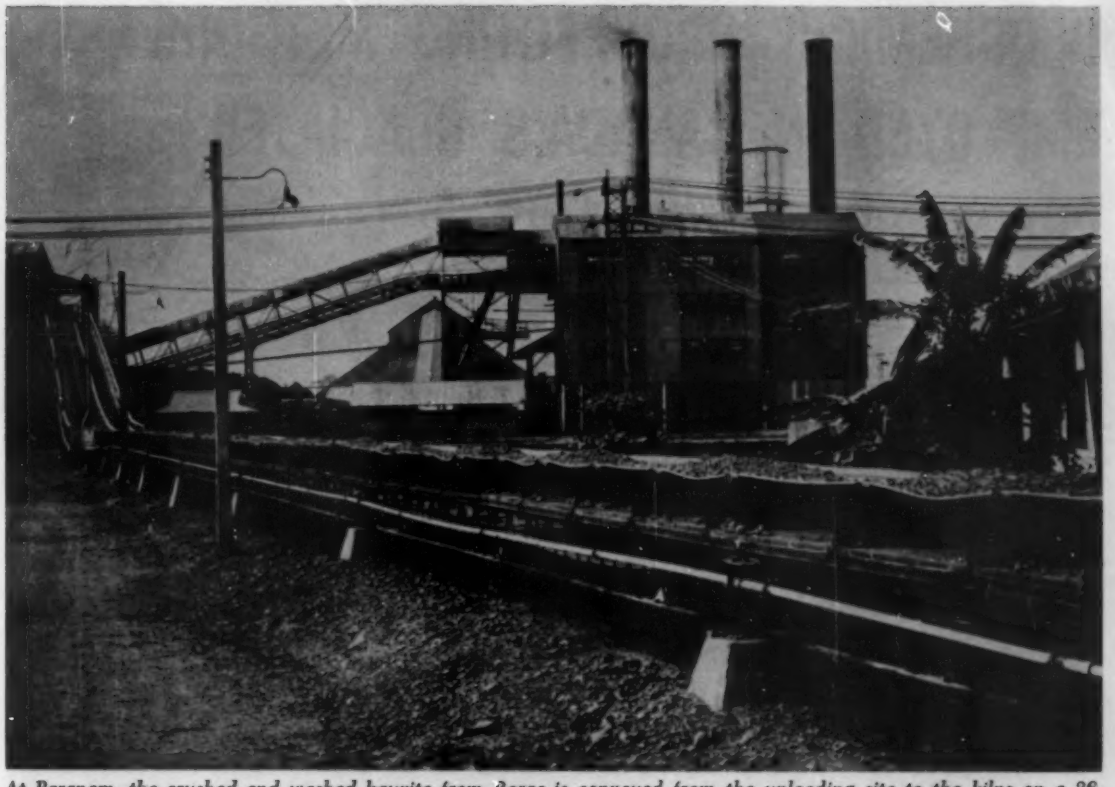
Upon arrival at Paranam, a loaded barge is positioned by the tug and the lines of a barge-moving system are attached. The winches then control all barge movements while the electrically operated clamshells are unloading.

The barge unloading installation differs from the loading dock system by the substitution of two unloading cranes and hoppers for the loading boom; the barge-moving winches and cables are identical. The two electric cranes are equipped with 3-cu yd rehandling-type clamshell buckets without teeth, which unload essentially −2-in. material. The cranes were purchased without crawlers, axles, and travel gears. Mounted on piling-supported pedestal bases, they are operated with live booms and tag-lines for easy positioning of the buckets. The main power substation about 300 ft away supplies 2300-v, 60-cycle, three-phase power.

The Model 54-B Bucyrus-Erie crane was selected for several reasons. Suralco had been using a 54-B electric shovel with excellent results as the principal excavation unit at another mine in Surinam. An additional shovel of this type was being ordered for the same mine. Savings were made in spare parts requirements, erection costs, and the training of operators and mechanics for the unloading installation by selecting dependable proven machines of sufficient capacity, such as the 54-B electric cranes. As the life of the deposits on the east bank of the river was estimated at considerably less than the life of the machines, the cranes would become available for other excavation purposes with the purchase of the travel mechanisms, or could be used as a source of parts for the other machines.



*A view of the barge unloading installation at Paranam. These facilities are on the west bank of the Suriname River.*



*At Paranam, the crushed and washed bauxite from Rorac is conveyed from the unloading site to the kilns on a 36-in. plant conveyor system (foreground). Kiln feed and dried ore storage buildings are located in the background.*

The cranes discharge into two elevated hoppers, each holding about 65 tons, placed midway between the machines and slightly behind them, and proper positioning of the barge allows an average swing of slightly less than 90°. Each machine is capable of digging about 350 tph, but because the slower clean-up process on the barges is done by these same machines, the unloading rate is reduced to about 285 tons per actual unloading hour. At this capacity, the machines are more than capable of handling the mine output. The crane operators have become so experienced in cleaning up the barges that they can remove 97 pct of the bauxite without using additional equipment, and the capacity of the machines is great enough for this to be done without causing delays in the shuttle schedule of the barges. This eliminates the need for additional barge cleaning equipment. The availability of the cranes, expressed as operating hours divided by the total operating plus repair and maintenance hours, was 92 pct in 1958. Most of the repair and maintenance work is done when no loaded barge is at the dock.

At Paranam the bauxite is discharged from the hoppers by apron feeders onto the 36-in. plant conveyor system. This conveyor system leads to a transfer chute in which an adjustable gate diverts the proper quantities either to a stockpile or to the drying kilns. The stockpiled bauxite is reclaimed through a reclaiming tunnel and fed to the system when there is no barge being unloaded. The ore is distributed to three kilns by a travelling conveyor tripper which dumps it into hoppers from which the material is fed to the kilns by apron (pan) conveyors. The dried bauxite is stored prior to being loaded in oceangoing ships.

## SUMMARY

The performance of the materials handling system has been very good since the beginning of the operation. This is primarily due to the efficiency of the loading and unloading installations. The inherent low cost of water transportation has been fully utilized. Very little lost time has occurred as a result of mechanical failures. The high unloading capacity of the cranes allows almost uninterrupted operation of the mine and mill when one of the units is in repair or overhaul. In addition, the cranes are frequently used for loading and unloading cargo or construction material, eliminating the need for other cranes on the river bank or docks.

As of mid-1959, approximately 3.9 million tons of bauxite have been transported from the crushing and washing plant at Rorac to the Paranam conveyor system at an average cost of $0.158 per ton. This cost includes all depreciation of equipment, overhead, salaries and wages, etc. The following table shows the division of these costs:

| | $ per Ton | Pct of Total Cost |
|---|---|---|
| Loading dock and equipment | $0.027 | 17.4 |
| Barge tramming, incl. tug | 0.065 | 41.0 |
| Unloading installation, less cranes | 0.022 | 14.1 |
| 54-B Bucyrus-Erie cranes | 0.044 | 27.5 |
| | $0.158 | 100.0 |

One cannot emphasize too highly the contribution of the electric cranes to this efficient operation. Their dependability has been a great advantage in producing an uninterrupted flow of ore from the mines to the ships.

# GEOCHEMICAL PROSPECTING METHODS EMPLOYED IN CANADA'S GLACIATED PRECAMBRIAN TERRAINS

by JOHN E. RIDDELL

This review is based on a questionnaire sent out in 1959 to 24 Canadian exploration companies, known to be active in the mineral exploration field, concerning their practice in the use of applied geochemical techniques in Precambrian terrains. Of the companies questioned, 21 returned completed questionnaires and of these, 15 companies stated that they had some experience in this type of work. Of the companies who stated that they had no experience in geochemical prospecting in glaciated Precambrian areas it is interesting to note that only three have reported that they do not use applied geochemistry at all. The others have reported that they make use of applied geochemistry in New Brunswick and in the Cordillera in areas of light glaciation. Their opinion is that it is a useful aid when accompanied by other techniques in evaluating mineralized areas.

## GEOCHEMICAL SURVEYS

Table I reviews the type of geochemical surveys used by these companies, and the following points of interest should be noted.

Geochemical surveys of bedrock by outcrop or by drillhole sampling have been almost completely neglected as a primary reconnaissance tool. This is despite the relationship of trace element content of certain igneous rocks to specific types of ore deposits, e.g., tin in the micas of acidic intrusives; copper and nickel in intermediate and basic intrusives; chromium and platinum in layered basic intrusives; gold in volcanics; uranium, thorium and beryllium in pegmatites. Furthermore, in spite of the oft-quoted belief that certain favourable types of sedimentary rocks are the source beds of ore deposits, e.g. zinc-lead in limestones and limey-argillites, copper in argillites and arenites, and uranium and gold in quartz pebble conglomerates, there has apparently been no systematic attempt to sample these formations on a regional basis.

Sediments are slightly more popular than soil as a sampling medium in reconnaissance work despite the deranged drainage pattern of much of the Shield area on the one hand, and on the other, the popular conception that glacial soils derived from ground moraine yield the best average samples of the chemical composition of the source areas. This probably reflects a lack of background data on the normal metal tenor of soils in various terrains.

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None of the companies reported the use of panning techniques as an aid to reconnaissance exploration. Yet concentration of heavy minerals by panning, followed by quantitative mineralogical and chemical analyses using *X*-ray diffraction and optical emission spectrography, should yield very informative results on the metal and mineral potential of an area or geochemical province.

Vegetation surveys are not used at all in reconnaissance work, and only three companies reported using water surveys. In view of the intimate exchange relationship between metal content of waters and metal content of sediment, which is dependent largely on *pH*, it would appear that determination of the metal content of waters is of equal importance to the determination of the metal content of sediments.

The returns on primary detailed surveys of claim groups indicate that 73 pct of the companies use soil surveys and 60 pct use sediment surveys. Most companies sample both types of material. Here again no use is made of rock sampling, despite the evidence of numerous research studies that fairly extensive primary dispersion aureoles are associated with replacement deposits. A limited use of water surveys is reported but vegetation surveys have been completely neglected.

A feature of the questionnaire returns is the wide application of soil and sediment surveys in testing interesting geological and geophysical phenomena. Apparently applied geochemistry is used here as a sorting technique, in order to ascertain suitable priorities for the second stage of various exploration projects.

## SAMPLING SYSTEM

Table II summarizes the soil sampling practices of the companies. There appears to be general agreement that the *B* soil horizon, if available, is the most satisfactory sample material. Two groups reported sampling the $A_1$ horizon (humus) in addition to the *B* horizon, and one group reported that it restricted its sampling to the $A_2$ (gray leached) horizon of the podzol profile. Three companies prefer to sample the soils lying immediately above the bedrock if at all possible. This procedure is somewhat difficult in glaciated areas because of the wide-spread ground moraine, containing numerous boulders, which makes augering difficult. Even where other types of glacial deposits are present at the surface, these are frequently underlain by ground moraine.

In Table III an attempt has been made to evaluate the results obtained in testing various types of glacial deposits. The answers to this section of the questionnaire were suitably vague and generalized, suggesting that most of the geochemical surveys had been carried out by hard rock geologists with little inclination to spend much time on a study of the unconsolidated surficial deposits. The impression gained from the returns is that satisfactory results were obtained only in ground moraine of limited thickness. Even for this material, over 25 pct of the companies which were surveyed reported unsatisfactory or doubtful results.

## ANALYTICAL PRACTICES

Table IV presents a summary of the analytical practices of the various companies. Sixty pct of the returns stated that field analyses were carried out at the sampling point; most of the companies also stated that some or all of the samples were checked by analyses in commercial or company laboratories. Three companies reported carrying out analyses in a temporary field laboratory, while an additional three companies make use of permanent company analytical facilities.

Eighty-six pct of the companies make use of a rapid field test for preliminary analyses. Only one company reported using a method developed by itself, all others made use of the Bloom test or commercial equivalents. Fifty pct of the companies stated that the samples are also analysed for total metal content by some form of quantitative techniques and, in addition, 20 pct of the companies run quantitative analyses on samples preselected by field test methods.

A variety of quantitative analytical techniques are employed, but 53 pct of the companies favor colorimetric analyses of acid extracts, or potassium bisulphate fusions. Four companies report checking their colorimetric analyses by other techniques, one by optical emission spectrography, one by *X*-ray fluorescence spectrometry, and two by polarography. Two companies depend entirely on *X*-ray spectrometry for quantitative analysis.

The results tabulated in Tables II, III, and IV indicate that most of the companies are testing *B* horizon soils for exchangeable metal (by field test) at the sampling sites. Many of the companies check their results by quantitative analysis of all samples. However, almost 50 pct of the companies either depend entirely on the field test analysis or only carry out quantitative analyses on samples that appear to be anomalous from the field test results.

In order to pinpoint bedrock concentrations of metal by this technique a number of favorable conditions must be present: 1) because the field test is far more sensitive to zinc than to other metals, it is almost essential that zinc should be very restricted insofar as lateral dispersion is concerned; 2) the mobility of zinc should be approximately the same as the mobility of other valuable metals so that the screened samples will give a true picture of the bedrock metallization.

These requirements are not normally satisfied under the weathering conditions in the glaciated Precambrian terrains. It is true that zinc is usually a minor element in most mineralized zones, but the amount of zinc present is highly variable and may bear no direct relationship to the total amount of economically valuable metallization. However the main problem is the mobility of zinc in the exogenic geochemical cycle. This mobility is pronounced under the rather acid conditions obtained in podzolic soils. As a result of this high mobility zinc rapidly becomes separated from the other metals during the course of weathering. Thus, soils which are high in zinc are not necessarily high in less mobile constituents, nor are the highest zinc values necessarily in the immediate vicinity of the bedrock mineralization.

**Table I. Types of Geochemical Sampling Employed**

| Purpose | Sampling Material | Pct of Companies Surveyed Using Sample Type |
|---|---|---|
| Primary reconnaissance surveys of large areas | Rock | 0 |
| | Soil | 27 |
| | Sediment | 53 |
| | Vegetation | 0 |
| | Water | 20 |
| Primary detailed surveys of claim groups | Rock | 7 |
| | Soil | 73 |
| | Sediment | 60 |
| | Vegetation | 0 |
| | Water | 20 |
| Secondary surveys of geological and geophysical phenomena | Rock | 7 |
| | Soil | 73 |
| | Sediment | 67 |
| | Vegetation | 0 |
| | Water | 20 |

**Table II. Summary of Soil Sampling Practices**

| Soil Horizon Sample | Pct of Companies Surveyed Using Sample Type |
|---|---|
| Humus | 20 |
| *A* horizon (gray leached) | 13 |
| *B* horizon (red stained) | 73 |
| Other (soil immediately above bedrock) | 20 |

**Table III. Summary of Geochemical Results From Glacial Materials**

| Type | Company Response | | |
|---|---|---|---|
| | Satisfactory, Pct | Unsatisfactory, Pct | Doubtful or No Answer, Pct |
| Ground moraine | 73 | 20 | 7 |
| Glacio-fluvial deposits | | 40 | 60 |
| Glacio-lacustrine deposits | 7 | 53 | 40 |
| Other glacial deposits | 7 | 27 | 66 |

**Table IV. Summary of Analytical Practice**

| | Pct of Companies Surveyed Using Procedure |
|---|---|
| Location of geochemical analysis: | |
| At sampling point | 60 |
| At temporary field laboratory | 20 |
| At permanent company laboratory | 20 |
| At other commercial laboratories | 53 |
| Type of analysis: | |
| Quick test methods (partial analysis) | 86 |
| Quantitative methods | 67 |
| Quantitative analytical methods: | |
| Colorimetric techniques | 53 |
| Optical emission spectrography | 7 |
| X-ray fluorescence spectrography | 20 |
| Other | 13 |

An addition weakness of the generalized program outlined above is that the usual field test makes uses of preliminary ammonium citrate extraction. This type of extraction is most effective on samples that are more or less permanently moist. The alternate drying and wetting, to which most soils are subjected, decreases the efficiency of the extraction. This, combined with the relatively low cation exchange capacity of inorganic glacial soils which are composed mainly of finely ground quartz, feldspars and ferromagnesian minerals, makes the field test relatively ineffective as a screening technique for inorganic soil samples. On the other hand, the ammonium citrate extraction is exceptionally effective for organic samples of humus and also for sediment samples from stream channels.

## CONCLUSION

The value attached to geochemical prospecting in Precambrian glaciated areas by the companies questioned in this survey varies from black to white. The two extremes are represented by the following comments received by the author:

> "Geochemical techniques can definitely be useful in the glaciated Precambrian terrains. Tests made in the vicinity of known mineralization gave satisfactory results. . . . Given certain favorable conditions such as sub-outcrop of mineralization and thin glacial cover, I see no reason why geochemical methods cannot be useful in finding commercial mineralization in Precambrian terrains, provided that some other control, such as geology, is used in directing and interpreting the geochemical program."

> "No value whatever in Precambrian glaciated terrains."

Other opinions are intermediate between these two, the companies' statements concerning usefulness being well hedged by a number of qualifications concerning the factors necessary for a successful application of the geochemical method.

In the author's opinion and experience, many glaciated Precambrian areas can be satisfactorily prospected for base metals using applied geochemistry, but there are few complete detailed and well documented published studies available in the literature. The returns from the questionnaire suggest that there is no unaminity of opinion concerning the usefulness of these techniques, and hence it would appear that such documented studies should be carried out and the results published. It is the author's belief that the information derived from such studies would readily repay the cost of making them by facilitating the discovery of new ore deposits and by eliminating costly duplication of research and exploration efforts.

# POPULAR INNOVATION AT GOUVERNEUR TALC CO.

# PLEXIGLAS MINE MODEL

by GEORGE E. ERDMAN

Gouverneur Talc Co. had sought an effective means of depicting its mine at Balmat, N. Y. since it commenced operations in 1947. After considerable research the engineering department settled on the idea of a model made of plexiglas at a scale of 1 in. to 50 ft. The solid portion of this model represents the actual underground excavations.

Talc is mined from two metamorphic tremolite-talc orebodies which are part of a complex fold system in this region. In the mine, stopes are laid out in panels and developed into openings 50 ft wide, 10 to 80 ft high, and perhaps 200 ft in length. Pillars usually approximate 30 ft in width. All present mining operations are contained within a block 2000 ft long, 1700 ft wide, and 1500 ft thick.

G. E. ERDMAN, Member of AIME, is Mining Engineer with Gouverneur Talc Co., Gouverneur, N. Y.

## TECHNIQUE OF MODEL CONSTRUCTION

The tools used to construct the mine model were all relatively conventional equipment. A jigsaw with a fine tooth blade (20 teeth per in. minimum) was used to trace all outlines of the component parts of the model. A Dremel Moto-Tool with a set of small saw blades and burrs was used to trim stopes to approximate underground shapes. Drafting triangles, clamps, weights, blocks, and pinch-type clothes pins were used in assembling the model. A cementing agent of plexiglas sawdust dissolved in ethylene-dichloride solvent was usually mixed to a tacky consistency 24 hours in advance of its use.

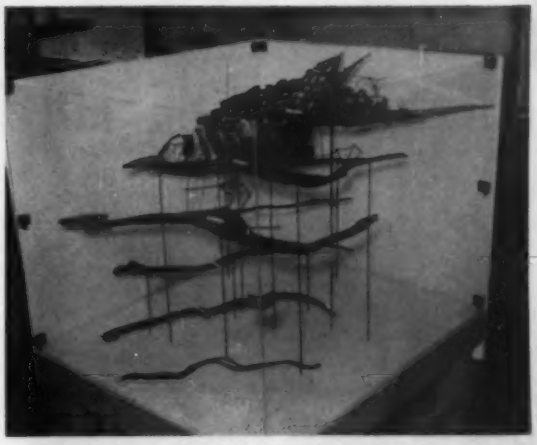
**Method of Construction:** The outlines of drifts and crosscuts were transferred from blueprints of mine maps to the masking paper of plastic sheets by using carbon paper under the blueprints. The plastic sheets to which the outlines were transferred were standard sheets of 3/16 in. No. 2451 Rohm and Haas amber plexiglas. A light table was used at all times to adjust the layout for a maximum economy of the plastic material. The drift outlines were then cut out with the jigsaw, smoothed with the burrs, and painted along the freshly cut edges with the solvent-plastic solution to increase transparency.

Raises were produced by a process similar to that of the drifts. The drift outlines were weighted in their proper positions on the blueprints and the raises were then cemented into their respective positions. Drafting triangles were used to project the raises to corresponding points on the mine maps. The raises were held in position for 20 min to allow the setting of the cement at the joint. Needles, weights, wood blocks, and pinch-type clothes pins were used in a variety of combinations to hold the model's parts in their relative positions while the cement was setting.

The procedure followed in stope construction was to contour the open stopes with colored pencils on a mine plan blueprint. Contour intervals corresponded to the scale thickness of the plastic sheets. The contour intervals followed one elevation of the stope along the hanging wall and the next higher elevation along the footwall. The resulting stope contour templates were transferred to the plastic masking paper and cut out by the jigsaw. When the templates were joined in their correctly projected positions, a "stepped" appearance was given to both the hanging wall and the footwall of the model of the stope. All excess plastic was trimmed to give the stope a smooth appearance approximating true underground conditions. Both hanging and footwalls of the stopes were smoothed with a fine conical burr and painted with the cementing solution to improve transparency, and the stopes were then cemented in their proper positions along the drifts.

**Assembly of Model:** The drift-raise units, previously cemented together, were then joined to the stope models with cement. Subsequently, a ⅛-in. thick green plexiglas sheet, cut to conform with the geological outline of the orebody at the drift levels of the mine, was fastened with wood screws to the stope-drift-raise assembly. Where stopes and raises passed through the green plexiglas sheets, the plastic was cut out to make the necessary openings. These junctions of amber and green plexiglas were cemented together after the various levels were clamped in their proper vertical and horizontal position.

The problem of supporting the plastic model within a showcase was solved by using ⅛-in. diam steel brazing rods, cut to the desired length and threaded on one end, inserted into holes drilled in the various green level sheets and the plywood base of the case. Small nuts on the threaded ends of the rods permitted minor adjustments in the elevations of the level sheets after the rods had been set in their proper holes. For further support, and in order to increase lateral stability, brackets and slots were used on the 3/16 in. clear plastic sheets which form the sides of the case.



*View of mine model as it appeared initially. "Honeycomb" effect in upper portion represents stopes, drifts, etc. Horizontal strips in lower portion show various levels.*

*The model as it appears today. It is the same as above except for the recent addition of the shaft and drifts of the nearby No. 2 Balmat mine of St. Joseph Lead Co.*

The completed reverse model consisted of a complex of amber mine openings supported on the green plastic sheets representing the levels within the deposit. The whole model is encased in a clear plexiglas case supported on a ½-in. plywood base. The showcase is 40 in. long, 35 in. wide, and 30 in. high.

## SUMMARY

The results of this work is a striking three-dimensional display of a small open stope mine, and it effectively demonstrates many of the structural features of the orebodies at Balmat. This presentation has proven very instructive to officers of the company, to visitors, and to operating personnel seeking to increase their understanding of geological structures and conditions.

# LETTER TO THE EDITOR

*This letter has been selected for publication from many constructive offerings received since the meeting of the Education Symposium at the 1960 AIME Annual Meeting. The editors regret that, due to space limitations, all of these letters cannot be printed.*

La Oroya, Peru
July 1, 1960

Being well on into the evolution of defining and discussing the problem of the future mining engineer is a healthy sign, but accompanied by adverse reactions. Today's philosophy points to avoiding the questionable, the statistically improbable, and the areas of limited maneuver or small opportunity. How then is the college student to choose mining engineering over electrical or mechanical or industrial engineering?

There is talk of advertising the profession and of changing curriculums and lengthening the study period to five years with its consequent increase of expense. But will there ever be a place for mining engineers? Neither the industry nor the profession has yet presented a clear cut definition why the mining engineer should exist at all.

Mining has a romance attached to it. It also has a rough-and-ready, chance-taking reputation. The work is publicly pictured as anything but a clean occupation. The shadow of *silicosis* and men trapped in human tombs has been well imbedded in the public mind. Why should the student take these added risks for the sake of romance? Mining is not a seductive beauty amongst engineering endeavors.

The industry and the profession now suffer growing or transition pains. The romantic, swashbuckling era is fitfully dissolving into a more mature age. Horseback "guesstimates" and brute force yields to the calm, calculated routine of any normally productive business using the most modern engineering and business techniques.

I have been privileged to know many grand old mining men. They have had many close calls, lived rugged sink-or-swim lives, and managed through it all to be successful. They are a special breed of people who are fiercely independent and individualistic in their approach to life. They have a depth of personality as well as being forthright of conviction. These are men who have been severely tested. Their wide range of abilities have been called into play to survive and to succeed. They hold life's precious experiences which have conditioned them to be the leaders of the minerals industries of today. They appear to feel that the leaders of tomorrow need similar conditioning to be successful. Herein lies what may be confusing our present day soul-searching about the mining engineers of the future.

Getting down to some hard realities vs. musing the past, what makes the mining engineer so uniquely necesary for the industry as to insure his future? Is not that the question which lies at the bottom of all the discussions?

Actually, fewer than 190 mining engineering graduates per year may be all the industry needs in numbers. Much of the engineering demands of the industry can and are met by other engineering disciplines. The mining engineer cannot master *all* the disciplines. Where then does he fit?

Mining engineering college studies were represented to me as offering the broadest of engineering disciplines. It also had some romance thrown in for good measure. Further, it was suggested that mining needed men sufficiently acquainted with a broad range of engineering disciplines such that each could be coordinated into a venture with maximum efficiency. Tacitly there was the idea that mining engineering studies lead to becoming a "quarterback" of the disciplines for a mining venture.

What a sales pitch! I went for it! When my class graduated, classmates were used as "rod men" etc., until having forced the issue, they were given a chance to practice what they were trained for, or moved out. Since that initial disillusionment, it became obvious that industry was not having any future "quarterbacks" unless they could meet every acid test of survival—unassisted! If you were going to become any sort of "quarterback" you were going to learn the "hard way" and be lucky, too!

There is much to be said in favor of this method of natural selection. Unfortunately, the casualties get a bit heavy.

Modern thought places somewhat less accent on constantly testing one's manhood. Students want the maximum of comforts to interspace a reduced number of tests of manhood. Mining becomes relatively unattractive especially in view of there being no obvious outstanding rate of remuneration over other less arduous occupations.

Frankly, I still feel there is a great deal in my professor's sales pitch for studying mining. Mining's strength (i.e., a broad knowledge of engineering disciplines) is dissipated by the industry which generally lends but passing attention to its new mining engineers. It does not deliberately capitalize on his unique preparation.

The new graduate is still not the mature man of good judgment. Judgment comes with working experience. While he tends to make some suprisingly sound decisions, he needs constant guidance in preparing himself for being a "team captain" of engineers, at some future date. Is he getting that guidance on a regular basis? Is that not why mining engineers fail to fill a uniquely valuable service to the minerals industry?

Many fine mining people have helped me see through older more experienced eyes much of the

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problems and successful strategems and tactics of the industry. Such help was rendered purely on a personal basis. I owe them a great debt that can never be repaid to them. Unfortunately, my observations have indicated that the electrical and management fields help their engineers in similar ways *on an organized and regular basis.* Mining men look at each other when one of them suggests going after an advanced degree *in mining,* but give encouragement to those seeking a degree in industrial engineering. What is industrial engineering but the understanding of a broad range of engineering disciplines, backed by certain special techniques? What has happened to the mining engineers' broad range of training? It appears to be buried under a pile of "romance" and acid tests and little or no guidance. The fierce individualism, independence and self-sufficiency of old time mining men, while truely noble and commendable on principle, tends to eliminate the less venturesome and less "self-driven" from the industry.

Accept that the venturesome and "self-driven" type of men are needed in mining. Are we going after the students who have those qualities? Are we going after just any student who can pass a college board? If the latter, the otherwise able student is going to pass on college mining theory and flunk on industrial experience. That is worse than not having him in the numbers of graduating mining engineers in any year.

When it can be stated with a degree of unanimity, even in a crude way, what the unique service mining engineers *can render the industry in the future,* then the colleges and universities can better prepare the future mining engineers.

Prestige, dignity and remuneration will come automatically as the profession comes closer to providing a unique service to industry. If a unique service is not found and provided, there will be no future for the profession.

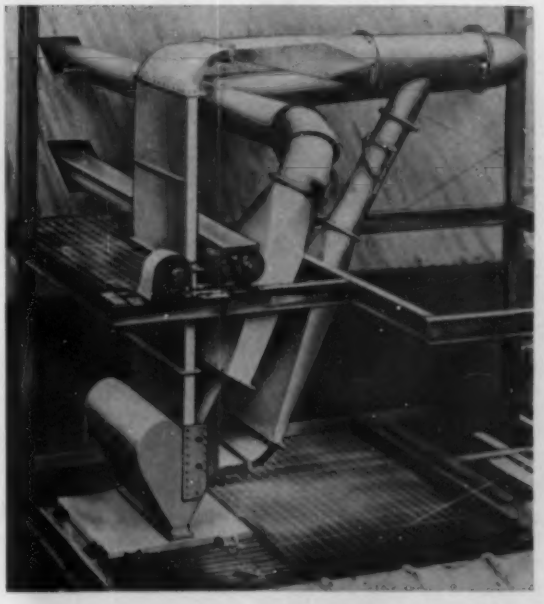
Dedicated people like Messrs. C. M. Brinckerhoff, S. D. Michaelson, H. R. Rice, J. D. Reilly and others are keeping the discussion alive. Each of us must, if we value the profession, continue it in search of salutary answers. Until we have them, we must realize that advertising is to sell and we are not selling a very sound item. Hence all the discussion about the item's future. *William G. Wood*

# SUCCESSFUL APPLICATION OF THE GRAVITATIONAL-INERTIAL CLASSIFIER

Crushed limestone is now being "de-dusted" at the Warner Co. plant in Bellefonte, Pa., by a new high-efficiency classifier utilizing aerodynamic principles not previously employed in classifiers. Crushed limestone for certain glass industry requirements must not have more than 10 pct fines in the overall aggregate, and it is the function of the new-type classifier to separate these fines from the coarse material. During the development of this classifier by the Buell Engineering Co. of New York, it was found to have possible applications for separating pulverized coal, sintered metals, ores, mineral flours, and fillers, among other items.

Limestone from Warner's deep mine is initially crushed and particles larger than ⅜-in. mesh are burned in kilns to provide calcium oxide for the chemical industry. The ⅜-in. screenings are dried and crushed to −16 mesh for use by the glass industry. For those applications requiring a minimum of fines, no more than 10 pct −100 mesh material is allowable in the end product. Hence the need for high-efficiency separation.

Warner originally separated the fines with a classifier of its own design, a satisfactory commercial model not being available. However, the results



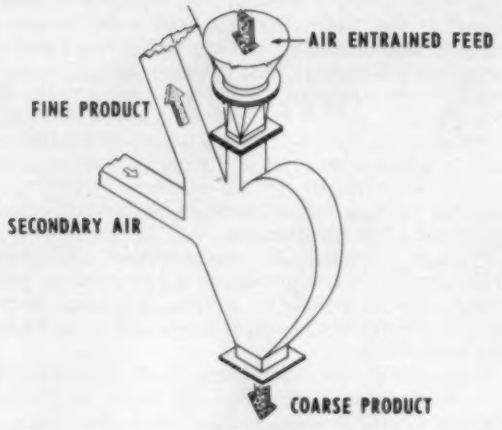



*Fig. 1*

were inconsistent, and the moving parts in the classifier presented maintenance problems. When the Buell Co. developed its "Gravitational-Inertial" classifier, Warner Co. was the first to install this type of unit in this country. The new classifier has no moving parts, except for a fan which circulates air through the unit and the fan motor, which gives virtual maintenance-free operations. Once it is set for a given separation or "cut" point, no further adjustment is required.

## OPERATION OF CLASSIFIER

A high-velocity air stream enters the classifier through the vertical duct (Fig. 1) and limestone is fed into the air stream by a screw conveyor. Coarser limestone particles travel downward through the bottom outlet, while finer particles are carried with the air stream as it makes an abrupt *U*-turn and exits through the upper inclined duct. A secondary air stream enters the classifier through the lower inclined duct, sweeps across the cascading coarse material, cleans away any adhered fines, travels around the inside periphery of the classifier, and exits with the main air stream through the upper inclined duct.

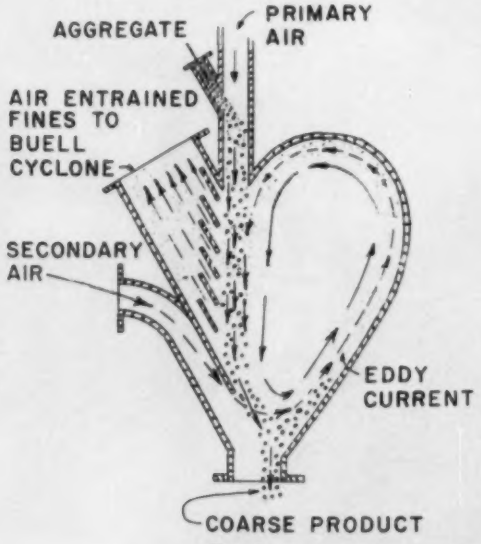



*Fig. 2*

Fig. 2 shows in detail what occurs within the classifier. As diagrammed, the entering air stream makes its *U*-turn into the inclined discharge duct shortly after entering the classifier, and simultaneously sets up a counter-clockwise eddy current in the body of the classifier. The vanes at the mouth of the discharge duct aid in the control of airflow. Fine material is carried out with the air stream but coarser material cannot make the turn and continues downward. The secondary air stream, in addition to scrubbing fines from the larger particles, reinforces the eddy current which provides a moving wall containing the curtain of feed material in the classifying zone without detrimental frictional effects of a solid wall.

By regulating the secondary air supply the cut-point (100 mesh in this case) is varied. Air is drawn through the inclined outlet duct at a constant rate and the velocity of primary air will therefore vary as the secondary air supply is varied. The velocity of the primary air determines the size of particle

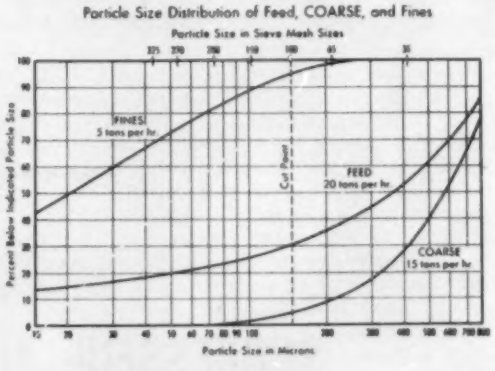



*Fig. 3*

which will or will not make the turn into the inclined discharge duct, since it determines the inertial downward force on a particle. To exit with the fines the inertial force on a particle must be small enough to be overcome by the drag force exerted on the particle as the air stream changes direction.

Discharged coarse material passes through a screen and tramp-iron remover upon leaving the classifier and is chuted directly into a freight car for shipment.

The airborne fines are pneumatically conveyed to a Buell high-efficiency cyclone some 200 ft away which separates them from the air stream and discharges them into storage bins for future leading into cars or trucks. The fines are sold for agricultural purposes and for mine dusting. Cleaned air from the cyclone is returned to the classifier for both primary and secondary air supply.

The company reports that about 15 tons of limestone are handled by the classifier each hour. Of this, approximately 22 pct is −100 mesh and 78 pct is + 100 mesh. The + 100 mesh material contains 3 to 5 pct fines, and the fines contain a like amount of + 100 mesh material (Fig. 3). The small amounts of oversize and undersize particles in the fines and coarse, respectively, are very near the cut point size. Particles of exact cut-point size can go either with the fines or with the coarse, and there is a small chance that particles close to the cut-point size will be collected with the wrong element.

REPORT FROM SALT LAKE CITY

# ROCKY MOUNTAIN MINERALS CONFERENCE

Sponsored by the Utah Section of AIME, the 1960 Annual Rocky Mountain Minerals Conference brought more than 500 members of the mineral industry to the conference rooms of the Newhouse Hotel in Salt Lake City during the period October 5 to October 7. Under the overall supervision of J. M. Ehrhorn, general chairman, and H. E. Wright, assistant general chairman, the Conference offered 14 papers of technical interest in four sessions during the first two days, and it culminated in the Exploration Symposium held on the morning of October 7.

The opening session of the Conference, meeting on the morning of October 5, heard R. P. Work, utility engineer of the Mountain Fuel Supply Co., discuss the growth and economic factors related to the use of natural gas in Utah. In his paper entitled *Natural Gas Market In Utah*, Mr. Work emphasized the very good prospects of natural gas serving almost all parts of that state. He mentioned that recently the El Paso pipeline, built to serve the Pacific Northwest with gas from Texas, has permitted natural gas to be available to Eastern Utah, and a tentatively planned pipeline from Green River, Wyo. to Southern California will bring natural gas to the central and southeast areas of the state.

*The Sonic-Resistivity Method of Log Interpretation* was the title of a paper delivered by J. L. Hallman, Jr., senior sales engineer of Schlumberger Well Surveying Corp. The author stated that the design of the sonic logging tool has been modified to improve the calibration and reliability. The fact that porosity of geologic formations can be accurately recorded by means of the sonic log has prompted new interpretation procedures for the estimation of saturation wherein the data concerning the various permeable beds exposed in a given drillhole are correlated.

In spite of man working on methods of salt production for untold centuries, there are still important processing problems to be solved. In his aptly named paper, *The Vicissitudes of Salt Production*, L. W. Ferris, former president of Bonneville Ltd.

*The panel of the Exploration Symposium. From left to right, S. S. Goodwin (vice president of N. J. Zinc Co.), host R. B. Mulchay (assistant chief geologist of The Anaconda Co.), C. P. Pollock (exploration manager of American Smelting & Refining Co.), moderator J. Boyd (president of Copper Range Co.), F. Cameron (president of St. Joseph Lead Co.), and C. C. Huston (president of C. C. Huston & Associates).*

and now a private consultant to industry, discussed the processing phase of salt production in various operations around the world.

The morning session ended after W. L. Budge, marketing manager of the Atomic Power Department of Westinghouse Corp., told the history of the pressurized water reactor, reviewed the reactor components, and discussed progress in both cost reduction of nuclear power generators and in the design and fabrication of nuclear fuel assemblies. His paper, *Nuclear Reactors*, also reviewed the method of analyzing the various aspects to be considered in selecting a nuclear fueled steam generator or the conventional "fossil-fuel" type generator. The author indicated the areas in which nuclear powered generators will be economically competitive with conventionally powered utilities.

On Wednesday afternoon, J. E. Willson, head of the Department of Mining and Geological Engineering at the University of Utah, offered a paper entitled *Geomechanics Laboratory at the University of Utah*, co-authored by J. R. Hoskins, associate professor at the University. In an attempt to improve methods of research employed in determining characteristics of mine rock, and aware of the inadequate information regarding the relationship existing between rock-in-place and normal laboratory test procedures, members of the university established a new geomechanics laboratory specifically designed for rock study. The program of basic research is one that necessitates deviation from standard equipment. Uniaxial and triaxial programming and recording devices, creep and relaxation compression machines, plus sonic and strain measuring instruments and sample preparation equipment have been built or modified to help solve specific problems.

The coal dryer installed at the coal preparation plant at Wellington, Utah, is the latest version in fluidized bed coal drying developed by the U. S. Steel Corp. In his paper *Fluidized Bed Coal Dryer at U. S. Steel's Wellington Coal Drying Plant*, W. L. McMorris, Jr., director of Coal Preparation and Distribution for U. S. Steel, detailed the major design changes in the dryer since the first two commercial installations were made at Lynnville, Ind., and Gary, W. Va.

*Oxidation in Flat Magnesium Surfaces* was delivered by Timothy E. Moss, a student at the University of Utah and author of this 1960 student prize-winning paper.

At Thursday's morning session, four papers were delivered. In *Reagent Systems Design*, J. D. Vincent, assistant milling engineer of Asarco, outlined the details of reagent control and flow at the larger mills in the West. In his talk, he also told the audience about provisions for the manufacture of flotation reagents at large copper mill sites.

Investigations by the U. S. Bureau of Mines in electrowinning tungsten and molybdenum metal from various concentrates or compounds by fused-bath electrolysis, and the electrorefining of such metals have shown significant results. A report on these studies was presented by D. H. Baker, Jr. and J. B. Zadra in their paper entitled *Electrolytic Tungsten and Molybdenum*. Among the data presented, it was noted that yields of tungsten varied between 400 and 650 grams per kw-hr and molybdenum, 300 grams per kw-hr.

Better utilization of "bacteria-power" was the theme of the paper *Role of Bacterial Oxidation in Leaching Processes* by E. E. Malouf, J. D. Prater, and A. W. Last. Bacteria play an important role in a hydrometallurgical process for copper recovery from mine waste at Kennecott's copper projects in Utah. Studies have been in progress for several years with the objective of applying these bacterial oxidation reactions more effectively to such copper recovery. This paper, presented by Mr. Malouf, outlined the results of these studies.

D. L. King, president and general manager of San Francisco Chemical Co., dealt with the problems of operating a medium grade deposit of low priced phosphate located 130 miles from the nearest railhead. In his paper, *The Vernal Phosphate Project of San Francisco Chemical Co.*, he described the mining operation and the metallurgical process at the plant and told how the economic factors were evaluated in arriving at the decision to mine the deposit although facing such major negative factors as its remoteness and grade.

The final session of the Conference commenced on Thursday afternoon when E. R. Borcherdt, mining consultant with Borcherdt & Smith, discussed The Anaconda Co.'s electric wheel truck now undergoing extensive testing at Butte, in his paper *Electric Wheel Truck at the Berkeley Pit*.

E. T. Hunter presented *The Silverton Project of Standard Metals Corporation*. This project in Colorado has three major objectives: 1) renewal of exploration and development programs at the old Shenandoah-Dives mine; 2) driving of a low-level access tunnel to permit reopening of the Sunnyside mine, closed since 1939, from a more workable location; and 3) modify and rehabilitate the Shenandoah-Dives mill.

The presence of metal-bearing nodules on the ocean floor has been known since the 1880's, but little or no systematic sampling and evaluation of these deposits had been done until the recent International Geophysical Year spurred interest in all phases of oceanography. Professor L. E. Shaffer of the University of California reviewed our present knowledge of such deposits in his talk entitled *Mining the Sea Floor* and commented on the econonic feasibility of recovering and processing this material. He noted that two major types of underwater deposits are known to exist. The first, and most widespread, are beds of manganese nodules composed of iron and manganese oxides with minor, but important, amounts of copper, cobalt, and nickel. The second type is composed of phosphorite which has recently been discovered in the shallow water off the coast of California.

The final session of the Rocky Mountain Minerals Conference, meeting on Friday morning, was the Exploration Symposium. One of the highlights of the Conference, this session drew not only exploration and mining men, but many leaders in the field of beneficiation as well. Moderated by James Boyd, president of Copper Range Co., the comments of the panelists and the ensuing discussion from the floor centered on the various economic facets of exploration, not on exploration techniques. Stress was placed on the long-range budgeting of regular expenditures for exploration, one which would be in ratio to the rate of ore production planned by a company over a period of years. To counter the historical fluctuation in the intensity of exploration activities by mining companies, pleas were sounded for greater *continuity* of exploration efforts over the span of years, and for the permanent maintenance of competent exploration staffs.

REPORT FROM LAS VEGAS

# AMC MINING SHOW

*Las Vegas Convention Center, site of AMC's 1960 Mining Show. One-fifth of a mile long, the building cost $6 million to construct. Featuring a 336-ft aluminum dome over the auditorium, the Center was completed in 1959.*

From October 10 to 14, the Land of the One-Arm Bandits played host to mineral industry engineers attending the Mining Show in Las Vegas. Sponsored by the American Mining Congress, one of the big attractions was the equipment display in which about 200 manufacturers of mining and construction equipment showed their latest wares.

But all was not just equipment displays. More than 70 papers were given in a program of sessions which were held on October 11, 12, and 13. These papers covered a wide range of interests from exploration and general operating problems, through mining and beneficiation, to the analysis of the state of the mining industries.

The sessions began on Tuesday morning when the first three meetings were held. One of these sessions dealt with the use of Public Lands in which the topics of the Wilderness Legislation, the degree of contribution and utilization of such lands, and the possible legislation dealing with the "pre-discovery problem" were discussed. One of the speakers, E. P. Cliff, assistant chief of the U.S. Forest Service, gave a progress report of that agency's administration of the Multiple Use Mining Law, enacted in 1955. Supplementing this talk on Government participation, Mr. E. Woozley, director of the Bureau of Land Management, dealt with the administration of P.L. 167, which allows the Federal Government the right to manage surface resources on all unpatented mining claims on public land located after July 23, 1955 and, in some cases, on claims which were staked prior to that date.

At a concurrent session related to exploration and geology, J. L. Mero from the University of California discussed the mineral resources on the ocean floor, the feasibility of mining such material, and supplied

*Above pictures show some of the displays at Las Vegas. More than 200 manufacturers and suppliers participated in showing modern equipment for the mineral industry.*

an overall design for a hydraulic dredge system that would be required for a large-scale, efficient operation. In his talk, K. J. Springer of Toronto told the audience about a syndicate method of exploration being used by many smaller mining firms in Canada. By pooling funds and personnel on new ventures, more thorough exploration over wider ranges can be accomplished by these companies, and they can spread their bets on success. E. E. Thurlow, chief mining geologist of the Northern Pacific Railway Co., discussed the modern approaches and tools required for large-scale exploration. The factors to be considered by a large mining firm in planning an exploration program to find ore to replace wasting assets were outlined by G. C. Waterman, chief geologist of The Anaconda Co. (Canada) Ltd. A discussion session, moderated by Evan Just, head of the Department of Mineral Engineering at Stanford University, was held after the presentation of the papers.

General operating problems were also discussed at one of the special sections held Tuesday morning. P. D. Bybee, general superintendent of the Grand Isle mine, discussed the challenge which Freeport Sulphur Co. faced in establishing sulfur production on the off-shore Grand Isle mine. As could be appreciated, much of the construction and many of the operations that would have been simple engineering tasks on land became very complex and expensive projects at this off-shore location. The 10-year, $60 million project to develop the Caland Ore Co.'s iron ore properties at Steep Rock Lake was the topic of P. P. Ribotto, vice president of that company. In addition to the above papers, A. W. Woods, mine superintendent of Trace Elements Corp., spoke on the use of radio communication in small mining operations, and the economics of truck vs. belt haulage of material was the subject of a paper by P. Nalle, mining superintendent of Riverside Cement Co., and D. M. Cooper, senior mining engineer of U. S. Borax & Chemical Corp. in Boron, Calif.

On Tuesday afternoon, four meetings were scheduled dealing with the subjects of taxes, industrial engineering, safety and health, and open pit mining. In the Industrial Engineering Symposium, R. M. Stewart and S. W. Hurlbut, both of The Anaconda Co., reported the results of a survey among 23 mining companies. They conclude that the use of industrial engineering—a management tool for controlling costs—has not been utilized to its fullest extent by the mining fraternity. Although the application of industrial engineering with the mining field is growing rapidly, some firms are trying to accomplish the job of industrial engineering without adequate use of professionals. During the ensuing discussion, B. Boyd of U. S. Smelting Refining & Mining Co. commented on the value to company and employees alike of establishing work standards measurements. If properly developed, he pointed out, such programs result both in cost improvements and improvements in human and labor relations. C. A. Cleeves, assistant mine superintendent at the Climax mine, reviewed the progress which his company has made in establishing work standards for plant employees.

At the meeting on Safety and Health, R. G. Beverly, administrator of Radiation Controls at Union Carbide Nuclear Co., discussed radiation control in uranium mining and milling. Use of foam as a secondary fire fighting method in underground mines was the topic of a paper delivered by B. W. Carey, assistant superintendent for Pickands Mather & Co. at Ironwood, Mich. E. C. Olsen of U.S. Steel Corp.'s Columbia-Geneva Steel Division discussed the important role of drilling to assist safe blasting. He also detailed procedures used in blasting with ammonium nitrate and fuel oil.

The first session on Open Pit Mining also met Tuesday afternoon. J. A. Fuller and J. R. Krause of the Reynolds Mining Corp. collaborated in a paper detailing their company's method of mining bauxite in Arkansas. C. L. Boise of Isbell Construction Co. called to the attention of the audience the importance of proper planning of the locations of maintenance shops, power and water supplies, and service centers at open pit mines. He said that layout of such facilities is one of the prime factors in any operation where minutes or seconds mean the difference between profit and loss. Also given at this meeting was *Economics of Various Methods of Overburden Stripping* by J. V. Otter of the Morrison-

Knudsen Co., and *Economics of Large Tires for Earthmoving Equipment* by G. E. Danby from the Euclid Division of General Motors Corp.

On the second day of scheduled meetings, all sessions were held in the afternoon. Labor relations was the subject of one meeting in which Senator B. Goldwater (Ariz.), J. S. Parker, vice president of General Electric Co., and Representative J. H. Dent (Pa.) participated.

Simultaneously, the first session on Underground Mining convened that afternoon. I. Janelid, professor of mining at Stockholm's Royal Institute of Technology, described the various mining methods employed at Kiruna, Malmberget, Grangesberg, and Strassa. He said that great efforts have been made to "rationalize" the subterranean operations by mechanization, remote control, and automation, and he foresaw the development in large mines of haulage systems controlled by means of data-processing machines. He also noted that sublevel caving is now the predominant mining method but block caving will probably become more common, especially in connection with deep-level operations. W. H. Harrison, Jr., general mine superintendent of Alcoa's fluorspar deposit at Rosiclare, Ill., described the development of a slusher system adapted to shrinkage stoping. He said that scrapers are being successfully used in removing fluorspar ore from narrow veins by drawing ore from the top of stope piles. Developments in large borehole drilling were analyzed by H. E. Mauck of Freeman Coal Co. and D. C. Ridenour of Olga Coal Co. Hoists were the principal topic of two other papers; one describing Inland's Steel's conversion of a drum hoist to a Koepe friction type for greater depth was delivered by J. R. Gronseth of Inland Steel Co. at Ishpeming, Mich., and the other, a report of the hoist installation at Asarco's Galena mine by N. Visnes, superintendent.

The first of two Milling and Metallurgy sessions was also held Wednesday afternoon. G. Atwood and J. P. McCarty, both of Duval Sulphur & Potash Co., delivered a talk entitled *Instrumentation for Process Control in the Milling of Copper-Molybdenum and Potash Ores.* R. G. Patterson reported on California Portland Cement Co.'s progress in achieving its ultimate goal of centralized plant control. In his paper entitled *The Krupp-Renn Direct Reduction Process* M. Kennard, vice president of Southwestern Engineering Co., said that although the *K-R* process can reduce low grade, siliceous, or finely disseminated iron ores to 92 to 95 pct metallic nodules, it is not necessarily the ultimate answer to all ores and conditions even though it has proven very adaptable to iron ores with a wide range of physical characteristics and chemical analyses. This session also included *Developments in Autogenous Grinding* by B. S. Crocker, vice president of Kilbourne Engineering Ltd., and the report by W. C. Hazen of Kerr-McGee Oil Corp. on the role of plastics in metallurgy for resisting abrasion and corrosion.

On the last day of scheduled meetings, four sessions met in the morning and five in the afternoon. The audience at the State of the Mining Industries session heard the presentation of analyses of the present and future economic outlook for nonferrous metals, iron ore, light metals, solid fuels, industrial minerals, special metals and rare earths, and our so-called "strategic" minerals.

The second session on Underground Mining, heard B. R. Waples, Jr., chief engineer of Shattuck Denn Mining Co., report on the high efficiency of the Alimak Raise Climber utilized at the Iron King Branch of Shattuck Denn. Detailing an unconventional drifting method employed at Howe Sound Co.'s Britannia mine in British Columbia, D. W. Pringle and H. Shuttleworth described the driving of a one-mile long exploration drift. This method produced a 595-ft advance in July. Other papers given at this meeting were by S. D. Woodruff, a civil engineer from the Los Angeles Department of Public Works, who spoke on *Practical Use of Rock Mechanics;* A. V. Mitterer and co-author B. T. Phillips, Jr., both with International Minerals & Chemical Corp., who discussed the use of ammonium nitrate in underground blasting; and W. Flanges, superintendent of tunnels at the Nevada test site, and L. E. Shaffer, professor of mining at the University of California, who analyzed the use of nuclear detonation in block caving operations.

The Tax Forum and the final meeting of Open Pit Mining rounded out the morning schedule. Among the five papers presented at the latter session was a report on open pit uranium mining operations in the Gas Hills area of Wyo. In this paper, R. Coulson, superintendent of Vitro Minerals Corp., outlined the complications of mining in this area due to spotty lenticular orebodies. Now in the testing stage, a new type of detonating cord which reduces noise and vibration in open pit mines and quarries was described by H. J. Poel of E. I. du Pont de Nemours & Co. In his paper, D. M. Stromquist of U. S. Steel told the audience of the ingenuity of some firms in devising more economical methods of mixing and handling ammonium nitrate-fuel oil mixtures for blasting. Also given at this meeting were *Scientific Techniques in Control of Open Pit Slopes* by A. Soderberg, consulting engineer for Kennecott Copper Corp., and *Cement Raw Materials—Variety in Mining* by E. B. Connors of the Permanente Cement Co.

In the final group of meetings held Thursday afternoon, one session was devoted to economic aspects of uranium and atomic power, and another to gold, silver, and monetary policies. A third session, Management Tools and Techniques, explored the uses of the research scientist, computers, and management consultants.

Meeting concurrently with these sections, the Underground Drilling Symposium and the Milling and Metallurgy session closed out this phase of the Las Vegas meeting. In the former session, J. H. Dewey, drilling research engineer of Inco delivered a paper on that company's underground drilling practices. The remaining time was then devoted to a panel discussion on drilling and maintenance practices. In the latter session, P. B. Hobsbawn, mill superintendent at the El Salvador mine in Chile, detailed the milling process of the copper ore from that mine. G. Craig, mill superintendent of Hecla Mining Co., reported on the construction of the Lucky Friday mine's new mill and surface plant, and R. C. McDowell, president of McDowell Co., delivered a paper entitled *Iron Making by the Dwight-Lloyd McWane Process.* The final two papers delivered at this session were given by H. F. Kullberg, manager of Jones & Laughlin Steel Corp.'s Minnesota Ore Division, who spoke on the gravity feed heavy media cyclone, and A. J. Kauffman, Jr., U. S. Bureau of Mines, who related developments in the treatment of rare metals and minerals.

REPORT FROM TUCSON

# SYMPOSIUM ON SURFACE MINING PRACTICES

Approximately 200 mining men traveled to the campus of the University of Arizona to attend the recent conference on Surface Mining Practices. Held on October 17 to 19, the schedule of events included four sessions devoted to the presentation of technical papers as well as a field trip to the nearby Mission Project of American Smelting and Refining Co. Also on the agenda was a discussion of the development of Nigeria's resources at the Monday luncheon, and a color film from the Marion Power Shovel Co. at the Tuesday luncheon which showed the loading of a new 150-ton capacity truck by a 13 cu yd shovel at a Utah open pit mine. In addition, the audience at the Monday night banquet heard Senator Barry Goldwater of Arizona talk on the competition from foreign mining projects.

The technical sessions began on Monday morning when E. R. Phelps of the Pittsburgh & Midway Coal Co. presented *Current Practices of Strip-Mining Coal* in which he outlined general strip mining practices presently in use by the coal mining industry. G. E. Pflug of the Riverside Cement Co. dealt with both the early and the present quarrying practices of his firm. In his paper *Limestone Quarrying, Production of Cement, and Related Problems at Oro Grande Plant, Riverside Cement Co.*, he discussed the diamond drilling program, equipment, computer control of quarry operations, and Riverside's mill operation. In the paper *Open Pit Mining of Phosphate Rock in the U.S.*, author G. D. Emigh of Monsanto Chemical Co. analyzed the characteristics of the several U.S. phosphate mining districts in terms of variation of the end-uses of the material, mode of mineral deposition, and techniques of mining this non-metallic product. The first session terminated after F. C. Appleyard presented *Open Pit Operation of Three-Vein Gypsum Deposit by Back-Cast Stripping Method*. This paper pertained to U.S. Gypsum's Alabaster, Mich., quarry where three veins of gypsum, all of different purity, are mined simultaneously to meet the requirements for a uniform ore grade.

The Monday afternoon meeting heard M. J. Hughes of Kaiser Steel's Eagle Mountain mine describe the equipment and operating methods employed to move 75,000 tons of ore daily from that mine. He detailed the equipment used for haulage and that required for drilling the extremely hard fractured rock. *Truck Mounted Rotary Blasthole Drilling at Inspiration* by T. M. Anderson described the unique problem of drilling at Inspiration's two pits, which have suffered from subsidence due to the earlier underground block caving operations. To meet the scattered and varied drilling requirements at this site, Inspiration is using a mobile 9-in. rotary drill which the author reported gives excellent performance, both from an operational and a cost standpoint. In his paper *General Blasthole Drilling at Silver Bell*, H. M. Conger of American Smelting & Refining Co. also discussed the use of a single 9-in. rotary drill in serving scattered mining locations at that open pit mine. The final paper delivered on Monday was D. H. Orr's *Maintenance of Main Line Haulage in Morenci Mine*. The author discussed the utilization, layout, and maintenance of the pit's 83 miles of standard gauge track.

A highlight of the conference occurred the following morning when a number of papers on computers and their applications were scheduled. A. W. Wymore of the University of Arizona discussed the basic operation, application, and limitations of computers in his paper entitled *Computers and Computer Applications*. In one phase of his talk, he demonstrated the use of the IBM 604 computer in solving elementary problems. *The Use of a Digital Computer in the Calculation of the Economic Limits of an Open Pit Mine Expansion* by J. F. Olk of the Pima Mining Co. described the determination of the economic limits of an open pit by computer analysis. Pima Mining Co. and the University of Arizona collaborated on this work. R. F. Hewlett of the University of Arizona followed with *Comparison of Various Methods of Calculating Ore Reserves Using a Digital Computer* in which several methods of estimating ore reserves were compared with the actual production record of the mined-out portion of the Silver Bell pit. The final paper of the morning session, *Estimation of Shovel and Dragline Output for Systems Analysis* by E. R. Drevdahl of the University of Arizona, was a detailed report of what these machines should be able to accomplish under various conditions.

Tuesday afternoon saw the last scheduled session meet. F. H. Buchella, Jr. presented *Use of Aerial Survey Mapping at the Esperanza Pit of the Duval Sulphur and Potash Co.*, co-authored by T. Jancic. The paper discussed the results, accuracy, and costs of aerial mapping and its application at Esperanza. *Materials Handling at Ray Mines Division's Expanded Concentrator*, a paper describing the change at the Ray-Hayden operation during the shift from underground to open pit mining, was delivered by F. G. Woodruff of Kennecott Copper Corp. Co-authored by E. C. Speers, the paper also dealt with the modernization of this mill. Concluding this aspect of the symposium's program, W. R. Hardwick of the U.S. Bureau of Mines reviewed the broad trends in the Southwest's open pit copper operations in his paper entitled *The Open Pit Copper Mine*.

REPORT FROM GOLDEN

# DRILLING AND BLASTING SYMPOSIUM

The tenth annual Drilling and Blasting Symposium, sponsored jointly by the University of Minnesota, Pennsylvania State University, and Colorado School of Mines, was held on the campus of the latter college October 16 to 19. Attended by 200 technical and production men from the U.S. and several foreign countries, the two topics of drilling and blasting were given equal emphasis at the conference.

The papers pertaining to drilling operations spotlighted the need for a better understanding of the basic mechanism involved in rock-breaking before major advances can be made in this field. In the blasting sessions the subjects of timing, spacing, drillhole inclination, ammonium nitrate mixtures and slurries, and the importance of the coupling of explosives were discussed.

Ross H. Goodrich opened the program with a paper entitled *Drag Bits and Machines* in which he presented data and experience gained during eight years of research by Joy Mfg. Co. at Claremont, N. H. The nomenclature of rotary bits was clarified by means of drawings, and the various types of bits were described and illustrated. Performance curves were given, and general conclusions drawn regarding the influence of various design factors on bit performance. He described several rotary drilling machines using illustrations and explained their applications.

A brief history of the development of rolling cone bits for the mine and quarry industries was traced by J. D. Medlock, staff engineer with Hughes Tool Co., in a talk on laboratory and field testing of rotary rock bits. He pointed out that present day bits for blast hole drilling are much improved over the bit designs of several years ago due to extensive laboratory and field testing of experimental bit features. These laboratory tests are made with full size bits and are conducted under controlled conditions to evaluate experimental features. He stressed that field testing is the final proving ground for evaluating experimental features of rock bits.

During the past three decades, the oil industry has expended increasing effort seeking improved drilling tools or systems that can reduce drilling costs. L. W. Ledgerwood, Jr., member of Jersey Production Research Co., reviewed the research and development which has been carried on in his paper *Efforts to Develop Improved Oil Well Drilling Methods*. Some of the possibilities which have been investigated are: impact at frequencies ranging from 6 to 300 cps; electrical, mechanical, and hydraulic means of actuating percussors; shock waves; high-velocity pellets; chemical attack; magnetic waves; reelable drill pipe; and automation of drilling rigs. In spite of this effort to replace rotary drilling with an improved system, rotary maintains its economic leadership. Ledgerwood believes that further significant long-range improvement is a research rather than a development problem.

The second session opened with a paper entitled *Rotary Percussion Air Hammer Drilling* presented by W. E. Liljestrand of Mission Manufacturing Co. in which he described the advantages of the new method of rotary percussion drilling with a down-the-hole type, air operated drill. The impact flow of the bit on the formation is like that of the cable tool while the high frequency of blows is like that of the wagon drill. Continuous hole cleaning and drilling is similar to that of rotary air drilling and the holddown is similar to cable tools in that almost none is needed. A down-the-hole hammer tool will drill at any depth that a hole can be cleaned of cuttings. The combination of these advantages results in drilling rates from 10 to 40 ft per hour depending on hardness of rock. Liljestrand pointed out that the best use of this drill is where formations are hard to dig. It is widely used in drilling of quarry and mining shot holes and has also been adapted to drilling oil wells wherever air or gas can be used.

In their paper *Higher Air Pressures for Bottom-Hole Percussion Drills*, co-authors W. D. Lacabanne and E. P. Pfleider, both from the University of Minnesota, raised the question "Shouldn't we be considering increased energies through the use of higher air pressures for large diameter bottom-hole units?" It has been standard practice in the mining industry for several decades to employ 90 to 100 psi air pressures irrespective of drill size or hole dimensions. A suggestive answer to the question was presented in a theoretical study on the effects of varying air pressures on the operating characteristics of percussive drills. Blast hole drills using low pressure air were compared to high pressure bottom-hole units recently developed in the oil fields.

Harley G. Pyles of Galis Electric & Machine Co., traced the development of *The Galis Rotary Percussion Drill*, a hydraulically driven drill designed to answer the need for a machine to drill harder materials without the use of compressed air. He told how, in seeking a percussive mechanism other

than a pneumatic hammer, various interrupter mechanisms were considered then discarded from the standpoint of maintenance and wear. Further research and development produced a satisfactory mechanical oscillator which could be driven hydraulically and a successful production model of the drill has been available for about nine months.

Idarado Mining Co. has increased the life of its drill steel six-fold by the establishment of research and test procedures. How this was accomplished was detailed by J. C. Keenan in his paper *Drilling and Drill Steel Progress at the Idarado Mining Co.* Simple methods of recording mine wide drill steel usage enabled the production-use evaluation of fabrication developments. Additional benefits, derived from the close study of drill steel life and drilling practice, have been the improvement of productivity and the lessening of machine maintenance cost. Air pressure studies revealed improved drill steel life with controlled compressed air distribution.

The final paper of this session, *Recent Developments and Trends in Production Blasthole Drilling on the Mesabi Iron Range* by Donald K. Nelson of M. A. Hanna Co., covered the gradual transition from mining soft iron formations to the more recent hard taconites. This trend has had a decided influence on the ratio of drilling to over all mining and haulage costs. While recent developments have concentrated on the application of vertical drill holes, some thought is being given to the use of inclined holes. The large diameter, vertical hole is still favored by the major operators but its production by turn drilling is rapidly giving way to rotary drilling.

The third session, held Tuesday morning October 18, was devoted to discussions of blasting techniques. Thomas C. Atchison of the U. S. Bureau of Mines opened the session with a talk on the effect of coupling on explosive performance. He described tests for measuring the effect of coupling on the strain produced by the detonation of an explosive charge in limestone. The strain is shown to be approximately proportional to the 1.5 power of the ratio of the charge diameter to the hole diameter.

Alan Bauer, a Ph.D. candidate at the University of Utah, outlined the Livingston Crater Theory and described certain preliminary stages in its application to open pit iron mining in his paper entitled *Application of the Livingston Theory.* This theory provides a method of designing single and multiple shot blasts using H.E. and/or nuclear explosives based on the relative behavior of materials.

This was followed by a discussion of some effects of particle characteristics of ammonium nitrate on blasting agent performance by George B. Clark of the Missouri School of Mines. He pointed out that more data is now available on the subject. Depending upon particle density, particle shape, and particle size distribution, explosives may be sensitive or insensitive to initiation. The same factors have a marked effect upon detonation velocity through control of mass reaction rates by particle size distribution and hydrodynamic parameters by control of the loading density. Though interdependent, Clark noted that a well defined relationship between sensitivity and detonation parameters has not yet been established.

The session closed with a consideration of ammonium nitrate slurry blasting agents by Melvin A. Cook of the University of Utah. He described the most recent developments of the slurry blasting agents including, in addition to recent field experience, new formulations of ever greater economic potential, fume studies, detonation pressure measurements by new aquarium method, and sensitivity results by the new high velocity impact method. Comparative results reveal a significant superiority of the slurry type blasting agents over other commercial types. He believes that the new era in blasting inaugurated by the introduction of "prills and oil" has been greatly strengthened and expanded by the introduction of the slurry blasting agents.

The last session of the conference opened with Nicholas M. Short's article *Post-Shot Exploration of Fracture Pattern Surrounding a Contained Explosion in Salt.* The author, a geologist with Lawrence Radiation Laboratories, described a study recently completed as part of the Plowshare program of industrial applications of nuclear explosives involving fracture patterns, plastic deformations, and physical changes produced in the surrounding medium by a completely contained high explosive detonation. By the use of carefully controlled mining methods, it was possible to re-enter the region of the explosion where large numbers of cracks delineated by traces of carbon were noted.

For all types of drill round cuts the drilling precision attained has limited the practical advance per round and the reasons for this deviation were discussed by Karl-Fredrik Lautmann in his paper *New Drilling and Blasting Techniques for Longer Rounds.* Possible advances with different types of cuts were considered, including some theoretical aspects of the *V*-cut. He told of the superior results obtained with the cylinder cut and discussed the different methods used to drill the center hole. A new type of cylinder cut, the Coromant cut, using 2¼ in. center holes designed for hand-held airleg rock drills, has given advances of up to 13 ft per round. Lautmann, a member of Sandvik Steel Works Co., cited production results, time studies, and the advantages of this method.

*Inclined Drilling in Quarry and Open Pit Operations* was the subject of Boris J. Kochanowsky's talk. The author, member of the Department of Mining Engineering at Pennsylvania State University, covered the theory and practice of inclined drilling. In the hope of gaining broader application of this method by arousing more interest among engineers and managers, he described results obtained with inclined drilling and explained its advantages. This technique has been adopted by more and more companies engaged in quarry, open pit, and stripping operations since it was first used in 1953.

In the final paper of the session, Richard L. Ash, from the Missouri School of Mines, explained that today's blasting practices require much more control than in the past due to changes in products and environment for use. In all multiple-hole blasts initiation-timing and drill-hole placement patterns must conform to rock structural characteristics in definite basic relationships. Multiple-hole blasts perform best when each hole and each row can complete its respective tensile and shear stressing processes, to provide uniform displacement and fragmentation. He gave illustrations of many basic patterns for the time, direction and linear proportioning of controlled balanced blasting, and discussed the determination of spacing dimension relative to that of the burden. He also considered the controversial subject of whether square or staggered multiple-hole arrangements are to be preferred.

# SME BULLETIN BOARD

*Reports of Your Technical Society*

## SME Program for the 1961 Annual Meeting

**St. Louis, February 26—March 2, 1961**

### Coal Division

1. Symposium on Froth Flotation.
2. Coal Preparation Plant Design.
3. Safety and Ventilation.
4. Materials Handling.
5. New Developments in Midwestern Coal Mining.
6. Symposium on Underground Mining.
7. Utilization, Carbonization, and Gasification.

### Industrial Minerals Division

1. Raw Materials for Chemical Industries in the Midwest.
2. Transportation of the Bulky Minerals
   (Joint with Council of Economics)
3. Industrial Waters.
4. Conflicting Interests in Exploitation of Industrial Minerals.
5. Foreign Trade Aspects of Fillers, Fibers, and Pigments.
6. Mineral Aggregates.

### Minerals Beneficiation Division

1. Crushing and Grinding.
2. Concentration.
3. Chemical Process.
4. Basic Symposium on Kinetics and Design (Joint MBD-ISD-EMD)
5. Materials Handling and Mill Design.
6. Solid Fluid Separation.
7. Operating Control.
8. Pyrolysis and Agglomeration.

### Mining and Exploration Division

1. Geochemical.
2. Geology (Joint with Society of Economic Geologists)
3. Geophysics for the Geologist and Engineers.
4. Open Pit Mining.
5. Research Symposium.
6. Underground Mining.
   (Division program also includes Jackling Lecture Session.)

### Council of Economics

1. Interfuel Session.
2. Percentage Depletion Session.
3. Transportation of Bulky Minerals (Joint with IndMD).

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# Scholarships

### Kennecott Copper Corp. Scholarships

The Utah Copper Div. of Kennecott Copper Corp., for the fifth year, awarded six scholarships to dependents of employes of the Division. The grant is for $500 and recipients may attend any accredited Utah institute of higher learning offering a baccalaureate degree and may enroll for any course of study they desire.

### University of Arizona College of Mines

Three new scholarships with a total value of $3400 annually were made available to students in the University of Arizona College of Mines for the 1960-61 academic year. They include five Daniel C. Jackling scholarships totaling $2500; a Thomas G. Chapman scholarship of $400; and a $500 scholarship established by the Min-A-Con Equipment Co. of Phoenix.

The Jackling scholarships include five awards of $500 each for students in mining and metallurgical engineering. Four of the awards were made to entering freshman and one to a student already enrolled in the college. The Thomas G. Chapman scholarship was given to a worthy upperclassman in the College of Mines and the Min-A-Con scholarship was awarded to an upperclassman majoring in mining engineering.

Four University of Arizona College of Mine students also have won Phelps Dodge Corp undergraduate engineering scholarships totaling $4000 for the present academic year. Award winners were Edward G. Mitchell, David Wilson, and Leslie P. Crawford of Tucson, Ariz., and Lee R. Williams of Reseda, Calif. The scholarships, amounting to $1000 each, are given annually to two outstanding mining engineering students.

# Education News

### Colorado School of Mines

Colorado School of Mines has received a $5100 grant from the National Science Foundation for use in the School's computer center, established in 1957, which contains both a digital and analog computer. The funds will be used to expand the facilities and services of the center to purchase a high-speed tape punch and recorder to speed up programming procedures for both machines. The computer is used in classroom teaching and in research.

Students at the Colorado School of Mines' experimental mine in Idaho Springs, Colo., have a new diesel locomotive to help them in their work. The Plymouth Locomotive Works of Plymouth, Ohio, and Hercules Motor Corp. of Canton, Ohio, joined together to donate a 6-ton Plymouth mine locomotive to the school.

After the dedication, a group of seniors from the school took charge of the unit. They represented seven nations—Canada, Brazil, Venezuela, Cuba, Chile, Burma, and U.S.

*Students in an international group from the Colorado School of Mines pose beside their new locomotive in front of the entrance to the School's experimental mine at Idaho Springs. Left to right: Edward Tutkaluk, Canada; John Fatum, Canada; Cluadio Marueron, Brazil; David A. Lyman, United States; Laszlo H. Vid, Venezuela; Roberto Karman, Cuba; Santiago Lehr, Venezuela; Ulrich Lorber, Chile; and Mya Soe, Burma.*

This is the first appearance of our new masthead. MBD Jr. is pointing out how the dull, lifeless material known as raw ore (or ROCK IN THE BOX) is concentrated to a valuable product known as the *MBD Digest*. This feat is accomplished by the application of equipment and principles which are simple to an MBD'er but completely mysterious to all other types of people, particularly those whose vocation is the more elementary occupation of delivering ore to the tender mercies of an MBD'er.

Part of the standard equipment of any MBD'er is to be able to say to any human being involved in the production of ore, any of the following opening or closing gambits:

1. "Ye gods! When did we start custom milling?" (This is reserved for locations where the only transportation is by airplane and the nearest neighbor is 500 miles away so that custom milling is an obvious impossibility, but it implies that the mine has discovered some new source of material which couldn't possibly be ore.)
2. "If this is ore, what are you doing with the waste? (Use this whenever the slightest rumor of higher grades comes your way—have an old assay sheet with a blurred date handy to prove your point.)
3. "Who said you were a miner?" (This is the effort to be used whenever you've had a clean, dry, uniform ore for at least three weeks and also have a clear escape route laid out.)

MBD Jr. suggests you send in any such gems you can recommend so that this method of defending our profession can be spread out to all members.

## Editorial Policy

From now on, this page will appear in the January, April, July, and November issues of MINING ENGINEERING, providing the Secretary-Treasurer meets the deadlines for this magazine. This method of operation is by edict of the MBD Executive Committee. By edict of the Secretary-Treasurer, there will be a dozen or so reporters appointed before the January issue.

## Newsletter

The second edition of the *Newsletter* should have been in your hands by October 1. It was scheduled for September 15 but a sudden and rigid requirement for economy slowed the production rate down to a more economical level. The *Double Buck of the Year* campaign shows signs of lagging. In fact, the well has gone dry. Please, if you have not already done so, send in your Double *Buck of the Year* campaign shows

This second issue of the Newsletter is a compendium of coming events within and without AIME in which members of MBD have some interest. Have you noticed the growing points of mutual interest between the AIChE and the AIME? You will in the AIChE programs noted in the second Newsletter.

The third *Newsletter* for 1960 will be published in time for the St. Louis meeting in February 1961 and will be your MBD guidebook for that event. Should you wish to attend the events sponsored by other groups, you are on your own, because no information except MBD activities will be in the *Newsletter*.

The last issue of the *Newsletter* went to a total of 4830 people, all of whom were in the AIME. Of these, only 1756 are MBD members. The others have all indicated Minerals Beneficiation as one of their areas of interest. This is quite an amazing total.

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The *MBD Digest* is for the use of the MBD members, to indicate coming events of interest to all members and to report on past events of interest to all. Please send to your Secretary-Treasurer, W. T. Marston, c/o Dorr-Oliver Inc., 77 Havemeyer Lane, Stamford, Conn., any items you wish to have included. Provided they are of general interest, they will appear in the next issue of either the *MBD Digest* or the *Newsletter*.—*W. T. Marston.*

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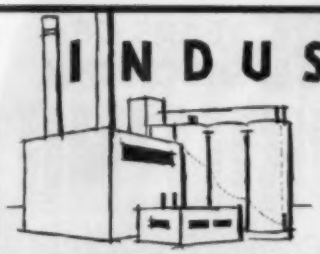
Reno, Nevada.....FAirview 9-0732
Spokane, Washington...WAlnut 4-2614
Alaska.....Contact Salt Lake City Office



# INDUSTRIAL MINERALS NEWSLETTER

Dear Members of IndMD:

Coming events of interest to members of this Division include two major meetings in addition to the annual Institute affair in February at St. Louis.

During April 1961, in Las Vegas, IndMD will join in the ever-growing and highly successful Southwest Minerals Industry Conference. J. K. Brooke, Southwest Regional Vice-Chairman of IndMD, has been appointed IndMD co-ordinator for this meeting. He advises that eight papers from IndMD have been scheduled for April 24 and 25. He has several papers firmly committed and, while the program will have a strong western flavor, he is anxious to have some papers on eastern topics also to generate broader interest in the meeting. Mr. Brooke may be reached at:

**Kaiser Aluminum & Chemical Corp.**
**Resources, Kaiser Center**
**Oakland 12, Calif.**

An Industrial Mineral Breakfast is planned for Tuesday, April 25th.

In the fall of 1961 we will join the Industrial Minerals Division of the Canadian Institute of Mining and Metallurgy for the meeting in Ottawa. We have had some wonderful sessions previously with our Canadian friends. Remember Nova Scotia? Co-ordinator for IndMD is Past-Chairman John Broughton. He reports that H. M. Woodrooffe is to be chairman of the joint meeting, which has tentatively been scheduled for October 2 and 3. The countryside of eastern Canada is usually very attractive that time of the year, so plan now to attend. Those wishing to present papers should contact:

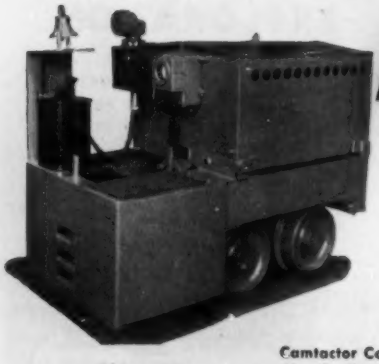
**John G. Broughton**
**N. Y. State Geological Survey**
**State Education Bldg.**
**Albany 1, N. Y.**

Many of the industrial minerals enjoyed substantial increases in 1959 over previous years, according to mineral market reports issued by the U.S. Bureau of Mines. Among those achieving new highs were gypsum, where domestic mine production was 14 pct above that of 1958; Portland cement production, up 9 pct; and masonry cement, up 13 pct. Vermiculite increased 8 pct in quantity and 13 pct in value; domestic mica increased 7 pct and exceeded 100,000 tons for the first time; ball clay was up 20 pct in quantity and 17 pct in value; other clays, including kaolin, bentonite, fuller's earth, and fire clay, also showed substantial increases. Crushed and broken stone production in 1959 exceeded 1958 production by more than 48 million tons, despite a slump in highway contract awards and the steel strike. Production of sulfur in all forms was up to 6.2 million tons, slightly over 1958 but well short of 1957 and 1956 production.

Products showing declines in 1959 output include dimension stone, down slightly in tonnage but 9 pct higher in value; domestic fluorspar, output down to the lowest figure in 21 years although total consumption of fluorspar exceeded that of 1958; and magnesite, where production decreased sharply, largely because of the steel strike.

Few people consider Florida a mining state yet, according to the U.S. Bureau of Mines, it ranked second in the nation in terms of value of shipments of nonmetallic minerals. The leading industries were phosphate mining and processing, cement, limestone, and titanium minerals. It is interesting to note that Florida's mineral production has more than doubled in value since 1952.—*John S. Holland.*


**...helps beat rising tonnage costs**



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# Around the Sections

• Members and guests of the **Lehigh Valley Section** met at the Grace mine in Morgantown, Pa., Friday morning, September 23, for a tour of the underground operations and surface plant as guests of Bethlehem Cornwall Corp. Upon their arrival, they were given hard hats and boots for the tour of underground operations. To assure maximum efficiency, the group of nearly 80 persons was broken down into parties of 10, each assigned two staff members as guides. A buffet lunch was served by the company after the underground portion of the tour was completed. In the afternoon the groups re-formed to inspect the surface plant.

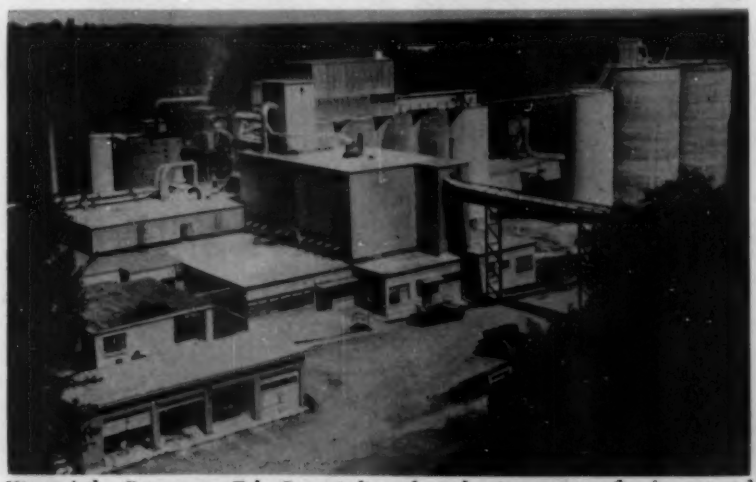
• The **Adirondack Section** joined with Sigma Delta Chi, journalism fraternity, in a tour of the Gouverneur Talc Co. operations at Gouverneur, N. Y., the afternoon of September 24. Section members met at 1:30 for a tour of the company's underground mine, an important producer for the paint and ceramic industry and probably the smallest mine in the country with an underground crusher. Tours of the mill were scheduled to start at any time from 1:00 to 3:00. At 4:00 there was a guided tour of the new *Tribune* press plant in Gouverneur. For those who were interested, golfing facilities were available in the afternoon at the Gouverneur Country Club, where the members met for dinner in the evening. After dinner a half-hour review of the mining and milling processes seen during the afternoon was given for the benefit of the journalists. In turn, a newspaper man gave a talk on the relations of the mining industry and the press.

*Curtis L. Burgess, standing right, receiving the Old Timers Award from last year's winner O. B. Bucklen during the annual dinner meeting of the Burkhart Mining Society.*

• Members of the **El Paso Section** heard Peter Puzzi, Darbyshire Steel Co., present a talk entitled *The Electric Furnace and New Developments in the Steel-Making Industry* at their first meeting of the fall season. The meeting was held September 14 in the ballroom of Hotel Cortez.

• The **San Francisco Section** met September 14 at the Engineers' Club, where E. R. Borcherdt of The Anaconda Co. presented a film and spoke on electric wheel haulage at Anaconda's Berkeley pit. This new development in ore haulage proved to be of great interest.

• The **Eastern North Carolina Subsection** (Carolinas Section) met Saturday, October 1, in Chapel Hill. The meeting began with a social hour and dinner. Ladies and students as well as members attended the affair. E. Willard Berry, speaker of the evening, gave a talk on the geology of Australia.



*View of the Gouverneur Talc Co. grinding plant showing storage silos for ore and finished products. Members of the Adirondack Section toured the plant September 24th.*

• *Future of Non-Ferrous Metals* was the subject of the September 29th meeting of the **New York Section.** Irving Lipkowitz, assistant to the president, Reynolds Metals Co., discussed aluminum; Simon Strauss, vice president, American Smelting & Refining Co., talked about lead, zinc, and copper. Since the talks were off-the-record the speakers were able to be frank in all their remarks. The dinner meeting was held at the Mining Club.

• Curtis L. Burgess received the 1960 Old Timers award at the annual dinner meeting of the **Burkhart Mining Society** (AIME student chapter at Virginia Polytechnic Institute). Presentation of the award, on behalf of the Old Timers Club, was made by O. B. Bucklen, who was last year's recipient. Mr. Burgess was cited as outstanding in scholarship and in student activities.

# Personals

H. E. RISSER

H. SCHWELLENBACH

A. I. ALTSHULER

W. B. HEROY, JR.

According to an announcement from the Illinois State Geological Survey, **Hubert E. Risser** has been appointed principal mineral economist. He has been serving as mineral economist since 1957. He replaces **Walter H. Voskuil,** who has retired.

The New York Trap Rock Corp. has announced the election of **John R. Kringel** as executive vice president. Mr. Kringel, previously vice president of production, is succeeded in that post by **Henry Schwellenbach,** formerly production manager. **Joseph A. Dooley** was promoted from sales manager to vice president for sales.

**Fred J. McCrory** has taken a position as assistant mining engineer with the Arizona Bureau of Mines at the University of Arizona in Tucson. He had been superintendent of the Tielio Unit, Volcan Mines Co., in Lima, Peru, for the past few years.

**Elis Dahlstrom** has accepted an assignment with the UN's Special Fund as project manager for a mineral survey of parts of northern Chile. The survey embraces geological and geophysical investigations in the southern part of the Tarapaca Province, the whole of the Atacama Province, and the northernmost part of the Coquimbo Province. It is estimated that the project will take two and a half years. Mr. Dahlstrom will make his headquarters in Santiago.

**James W. Kinnear, Jr.,** was recently appointed vice president for the Steel Producing Divs. of U.S. Steel Corp. He was formerly executive vice president of the corporation's Tennessee Coal & Iron Div.

**J. F. Wickham** has been promoted from mill superintendent to general superintendent of the Chilete unit of American Smelting & Refining Co. at Chilete, Peru.

According to an announcement from Behre Dolbear & Co., **H. I. Altshuler,** mining engineer and vice president of N. Y. & Honduras Rosario Mining Co., has become an associate member of the firm. It was also announced that **Parke A. Hodges,** vice president of the firm, has gone to Australia on professional work; **A. F. Banfield** is making technical investigations in Europe and joined **Charles H. Behre, Jr.,** at the International Geological Congress in Copenhagen, Denmark, where Mr. Banfield presented a paper on the mineral resources of Iran.

The board of directors of The Geotechnical Corp. recently announced the election of **William B. Heroy, Jr.,** to the office of executive vice president. He joined the company in 1945 and subsequently became a vice president and a member of the board of directors.

**John J. Reed** has joined the faculty of the Colorado School of Mines as a professor of mining engineering. For the past five years he has been head mine research engineer for St. Joseph Lead Co., where his principal research has been on rock mechanics, rock drilling and fragmentation, and grouting.

**William H. Evans,** who has been employed as a project engineer by Western Knapp Engineering Co. for the past six years, has taken a similar position with Traylor Engineering & Mfg. Div. of Fuller Co.

**Thor H. Kiilsgaard,** geologist with the USGS, recently returned from a three-month trip to Bolivia, where he was a geologic consultant to the U.S. International Cooperation Administration and the Bolivian Government. In 1958-1959 he spent six months in southern Peru evaluating mineral deposits as part of a joint project undertaken by the U.S. and Peruvian governments.

**Irving Whitehouse** has been appointed director of research for Republic Steel Corp. to succeed the late **Earle C. Smith.** Prior to this appointment, he was assistant director of research. **John Hazel,** former chief ceramic engineer and head of the ceramic division of the company's research center in Independence, Ohio, replaces Whitehouse as assistant director of research.

**F. S. Elfred,** chairman of the board of Peabody Coal Co., has been named chairman of the program committee for the 1961 Coal Show of the American Mining Congress to be held in Cleveland next spring.

**Pitt W. Hyde** has returned to the U.S. after serving for three years with the International Cooperation Administration in Korea as chief of the mining division. He and his staff helped to increase the usefulness of Korea's anthracite coal and furthered the exploration of other mineral resources. They also assisted in experiments with lignite and helped survey iron deposits. As a result of their activities a program was set up to improve the quality of normally low-grade anthracite by washing and screening. An appraisal of lignite deposits produced a promising supply of this brown coal and experiments are planned to determine the possibility of producing gas from it.

*Pitt W. Hyde, chief of Mining Division of ICA Mission in Korea, pictured working beside a Korean coal miner as part of his assignment to improve mining operations.*

After 12 years with Torbrit Silver Mines Ltd., where he was employed as mine superintendent at the time of his departure, **Harry Bapty** has taken a position as field engineer with New Consolidated Canadian Exploration Ltd.

**William R. Tise** has been transferred from Los Angeles, where he was western belting engineer for U.S. Rubber Co., to the East Coast where he is now chief belting engineer.

**R. M. McAlexander,** formerly with Gunnison Mining Co., has been appointed mining engineer-geologist with Peru Mining Co. at Hanover, N. M. The company is owned by American Zinc, Lead & Smelting Co.

**Robert P. Connett** has returned from Jamaica, B.W.I., where he had been working for Jamaica Gypsum Ltd., to work for U.S. Gypsum Co. in Plasterco, Va.

**Edward C. Peterson** has moved to Puerto Ordaz, Venezuela, where he has taken a position with Orinoco Mining Co. He had recently moved to Hibbing, Minn., where he was a mining engineer with Pickands Mather & Co.

**Wallace T. Dow** has left Peru Mining Co. in Hanover, N. M., to work for Kennecott Copper Corp. at Santa Rita, N. M.

**Harold N. Ewoldt,** formerly director of planning for Cerro de Pasco Co. at its New York headquarters, has become project manager for Beacon Construction Co. in Oscoda, Mich.

For the past 18 months **Raoul G. Bergman** has been serving as a mining advisor for the U.S. International Cooperation Administration in Yugoslavia. His assignment is to assist and advise in selection, mining, and processing of chrome ores used by the Magnohrom Enterprise in Kraljevo, Serbia. Before going to Yugoslavia, Mr. Bergman was associated with Newmont Mining Corp.

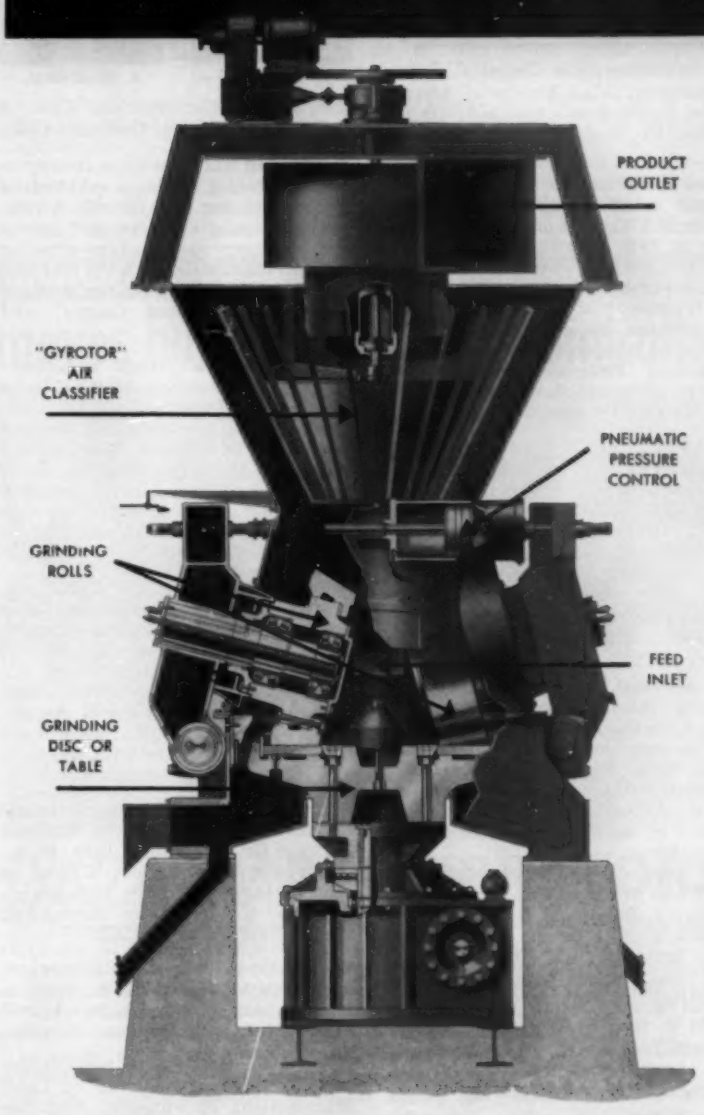
**J. Delano Hitch, Jr.,** has resigned as chairman of the board of directors of Dorr-Oliver Inc. He will continue to be active as a director and as a consultant under long-term contract to the company.

Jones & Laughlin Steel Corp. has announced the appointment of **Thomas Stephenson** as chief engineer for the Minnesota Ore Div. Other appointments in the division's engineering department include **William Betzler** as assistant chief engineer in charge of operations and **Roger Moen** as assistant chief engineer of development.

**George M. Marincel,** formerly metallurgist for Charleston Iron Mining Co., has taken a position with Erie Mining Co.

**H. Turner Loehr,** previously in the phosphate mining division of Inter-


DISC-ROLL MILL

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## personals

continued

national Minerals & Chemical Corp. at Barstow, Fla., has been transferred to the firm's headquarters in Skokie, Ill., as director of engineering.

**James E. Quinn** has been appointed general sales manager for Denver Equipment Co. He joined the company in 1948 following his graduation from the Colorado School of Mines. Mr. Quinn was manager of the Western Div. prior to his new appointment. He has also been in charge of the company's Uranium Processing Equipment Sales Div. and is a recognized authority on uranium ore treatment.

J. E. QUINN

W. MITCHELL, JR.

**Will Mitchell, Jr.,** was recently appointed acting director, Research Div., Allis-Chalmers Mfg. Co., to fill the vacancy left by the death of **H. K. Ihrig.** He had formerly been associate director of the Division. He joined Allis-Chalmers in 1947 as director of the firm's basic industries laboratory.

Mr. Mitchell is Past-President of AIME and formerly a member of the Institute's Board of Directors and the Board of Directors of the Engineers Joint Council. He serves as Allis-Chalmers representative at the Industrial Research Institute.

**Euclid P. Worden** has gone to work Hughes Tool Co. as a junior engineer after graduation from the Colorado School of Mines.

**Allen T. Cole,** who has been operating a minerals consulting office in Lakeland, Fla., for the last five years, has been appointed property manager for the Florida and Tennessee phosphate operations of International Minerals & Chemical Corp. He will be in charge of acquisition of land reserves, utilization of properties prior to mining, and reclamation of mined-out areas.

**J. A. Conwell** has recently undertaken a one-year assignment as resident manager for Kaiser Engineers & Constructors Inc. on the construction of facilities for an experimental atomic reactor in Viet Nam. Before accepting this assignment, he was assistant manager of

E. GOFF

R. HENDERSON

the Heavy Construction Div of Henry J. Kaiser Co., Oakland, Calif.

**Ernest Goff** has joined the faculty of Vallejo Junior College as head of the engineering department. A consulting mining engineer and geologist for many years before entering the educational field, he has traveled throughout the U.S., Alaska, Mexico, Canada, Cuba, and Central and South America.

According to a recent announcement from American Metal Climax Inc., **Robert Henderson** has been appointed vice president of western operations of Climax Molybdenum Co., one of the firm's divisions. Heretofore he has been general manager of the company's western operations and has been associated with Climax since 1936.

**John H. Torreano** has been appointed superintendent of the Tobin Ore mine, where he has been working as mining engineer since the fall of 1943, according to a recent announcement from Republic Steel Corp. He succeeds **Edwin H. Anderson,** who retired this July after more than 40 years' service with Republic and its predecessor company.

**Leamon G. McGee,** formerly maintenance superintendent for National Gypsum Co. in National City, Mich., has moved to Princeton, W. Va., to become industrial sales representative for the company throughout West Virginia and Virginia.

**Wayne G. Basler,** a research engineer with Aluminum Co. of America for the past four years, has joined Ford Motor Co. in the same capacity.

**Douglas L. McCullough** has become affiliated with the Bureau of Land Management at Phoenix, Ariz. He was formerly a staff assistant at Fisher Contracting Co., also of Phoenix, before taking this new position.

**Michael Bikerman,** who has been an instructor at Boise Junior College for the last few years, has enrolled in the University of Arizona as a graduate student. He will be investigating welded tuffs (ignimbrite) and would welcome correspondence on them.

**Lester F. Engle, Jr.,** has moved North from Port Nickel, La., where he was employed by Freeport Nickel Co., to beocme associated with Western-Knapp Engineering Co. in Chicago.

R. A. RATH

J. H. WREN

At a meeting of the board of directors **Robert A. Rath** was elected vice president of sales of Spang & Co. Prior to this he had been sales manager of Butler Refractories, a Spang affiliate.

**James H. Wren,** of J. H. Wren & Co., consulting mining engineers in Sacramento, Calif., has returned from an extended mine evaluation and production alignment reconnaissance trip to various mining projects in South America. Major professional work was done for the Howard P. Morrison industrial consulting firm of Washington, D.C., in French Guiana's placer gold fields; for Western Hemisphere Resources Corp. of St. Paul at its extensive placer gold concession on the eastern slopes of the Andes in Ecuador; and for the Ecuador Dredge Corp., which is conducting an evaluation project in an area of ancient Inca and Spanish gold production on the Zamora River of Ecuador.

The International Salt Co. recently announced the appointment of **Frederick W. Pfau** as manager of its Detroit rock salt mine. He has been general superintendent of the mine since 1959 and has been with the company since 1930. Mr. Pfau succeeds **John L. Ryon, Jr.,** who has been named assistant director of production at the company's headquarters in Clarks Summit, Pa. He has been with the company since 1949 and has worked at the Detroit mine since 1957 as assistant manager and then as manager.

**Paul F. Kerr,** Newberry Professor of Mineralogy at Columbia University, is lecturing NATO guest professor at the University of Oslo for eight weeks this fall. He has prepared a sequence of graduate lectures and seminars devoted to recent research developments in mineralogy as carried on at Columbia. The program will include work in fine-grained minerals as developed over the years in Columbia's department of geology.

**G. W. Josephson** has been transferred from the Washington, D. C. office of the U.S. Bureau of Mines to the Pittsburgh office, where he is serving as chief of the Division of Mineral Resources for Region V.

**A. C. M. Laing,** formerly geologist with Mines Administration Pty. Ltd. in Brisbane, Australia, has become affiliated with B. P. Shell Todd Development Ltd. in Gisborne, New Zealand.

J. R. GREENLY

H. RUMFELT

W. L. DOWDEY

D. DAHLSTROM

**John R. Greenly** has been named manager of the Lake Shore Steel Warehouse division of Lake Shore Inc. He will also continue as manager of the company's service and supply division, spearheading the firm's new program of expanded steel service and supply operations in the Michigan Upper Peninsula and Wisconsin areas.

**Henry Rumfelt,** mining engineer in the International Division of Bucyrus-Erie Co., was awarded a professional degree in mechanical engineering from Texas A & M College (his alma mater) in recognition of his achievement in strip mining techniques and for his thesis on a new approach to stripping problems which he submitted in partial fulfillment of requirements for the degree.

The Eimco Corp. recently announced the election of **Wayne L. Dowdey** and **Donald A. Dahlstrom** as vice presidents. Dowdey joined Eimco in 1945 and was general sales manager at the time of his promotion. Dahlstrom was director of Eimco's Research & Development Center at Palatine, Ill., and will continue his work there. He came to Eimco from the faculty of Northwestern University in 1952.

Upon graduating from the Mackay School of Mines, **Theodore F. Taylor** has gone to work for Original Sixteen-to-One Mine Inc. in Alleghany, Calif., as a mine engineer. His immediate supervisor, **Clayton A. Bennett** is also a Mackay alumnus from the class of 1910 and has been associated with the Alleghany mine for about 30 years.

**Karl Ruhe,** formerly valuation engineer for the U.S. Treasury Dept. in Wichita, Kan., has been transferred to Washington, D. C., where he has been appointed program manager for the field engineering operations concerned with the administration of tax laws by that agency.

**C. C. Griggs,** who had been conducting a consulting engineering practice specializing in federal tax matters since 1951, with offices in Edgewater, Md., has retired recently at the age of 85 and is making his home in Philadelphia.

**Fred W. Menzl,** formerly plant superintendent for the Western Div. of Basic Inc. at Gabbs, Nev., has started his own consulting business in Phoenix, Ariz. For the past six months he has been doing consulting work for Siskon Corp., developing brucite and magnesite properties in California.

**Walter F. Pond,** consulting geologist of Greybull, Wyo., and Malvern, Ark., has recently completed for a client acquisition of several thousand acres of barite-bearing lands in the Potosi, Mo. fields and has returned to his home in Greybull. He first came to Greybull in the early '50s as chief geologist for Magnet Cove Barium Corp. and discovered and staked claims on several million tons of bentonite which led to the construction of the company's present bentonite-processing plant.

**S. S. Pierce,** who has served as mechanical engineer with the Strategic Air Command, U.S.A.F., in London for the past seven years, has been transferred to the Air Materiel Command at Hill Air Force Base, Utah, as an industrial engineer.


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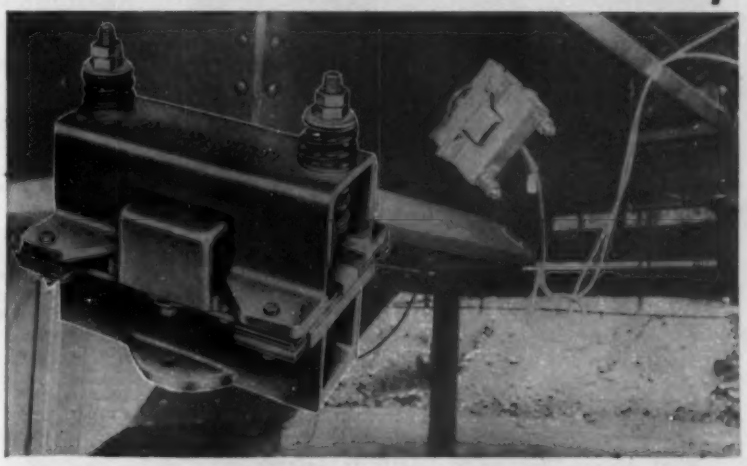

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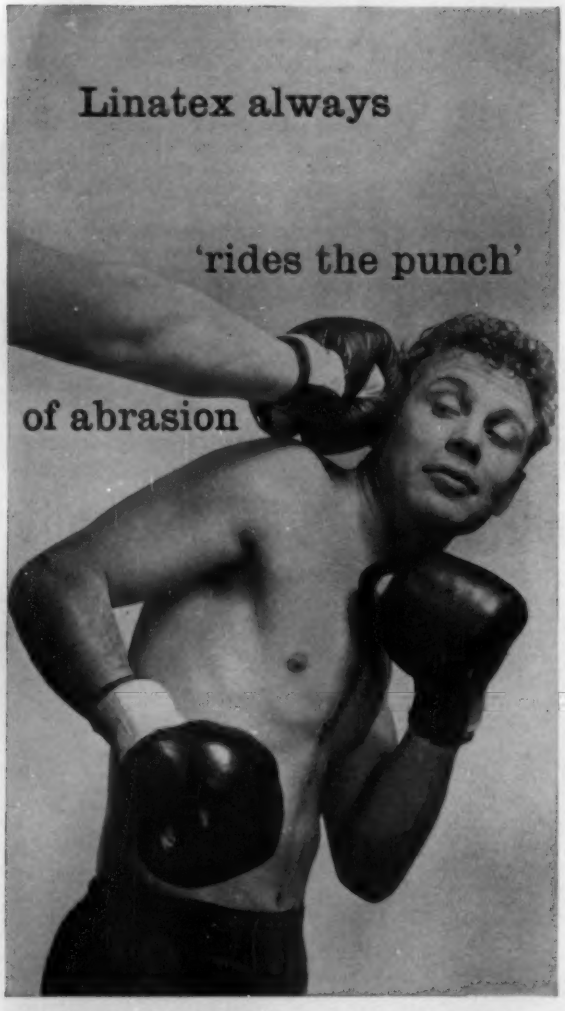


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# Obituaries

**Murl Harold Gidel**

An Appreciation by

Reno H. Sales, George G. Griswold, Jr., Edward P. Shea

Murl Harold Gidel (Member 1913) passed away in his sleep on March 18, 1960. Word of his death brought expressions of deep regret from his numerous friends and associates all over the world. Although a brilliant leader in his profession, he always found time to give helpful counsel to the many men who worked under him. This resulted in innumerable enduring friendships developed during the 45 years of his distinguished career. Although he was not a teacher, many outstanding earth scientists received their early training under his expert guidance.

Mr. Gidel was born in Joliet, Ill., April 22, 1889, and was brought to Montana by his parents when he was a year old. He was associated with mining all his life, as his father worked as a millman at the old Bluebird mill and later as a miner in Butte and Rimini near Helena. An ambitious and energetic youth, he started at an early age delivering the old *Butte Miner*, a morning newspaper, and later took charge of the city circulation routes, a job he held through college. He learned bookkeeping at the Butte Business College and was an assistant teacher there while still a senior at Butte High School. He graduated from high school in 1908, and subsequently, while attending the Montana School of Mines, he was part-time laboratory assistant and secretary to D. C. Bard, head of the geological department. During his college years he gained additional mining experience by private leasing during the summers. Mr. Gidel received the degree of Engineer of Mines from the Montana School of Mines in 1912. He

## Murl Harold Gidel

Memorial Resolution Prepared by *Reno H. Sales*, *George G. Griswold, Jr.*, and *Edward P. Shea*

WHEREAS, with the passing of Murl Harold Gidel at his home in Butte, Mont., on March 18, 1960, the American Institute of Mining, Metallurgical, and Petroleum Engineers has lost one of its most distinguished members; and

WHEREAS, Mr. Gidel was, during his active life, one of the most prominent geologists in the mining and oil professions and assistant chief geologist of The Anaconda Co. at the time of his retirement January 1, 1958; and

WHEREAS, he had been a member of the American Institute of Mining, Metallurgical, and Petroleum Engineers since 1913, and had served as chairman of the Montana Section in 1931; therefore, be it

RESOLVED, that the Montana Section of the American Institute of Mining, Metallurgical, and Petroleum Engineers records with deep sorrow the loss of this distinguished geologist, friend, and member; and

BE IT FURTHER RESOLVED, that this Resolution will be spread on the minutes of this meeting and a copy sent to the family of the late Murl H. Gidel; also that a copy be sent to the editor of MINING ENGINEERING.

**June 6, 1960**

then joined Anaconda Copper Mining Co. and continued in the company's service until his retirement on Jan. 1, 1958, at which time he held the position of assistant chief geologist.

Most of Mr. Gidel's professional work was devoted to the effort of locating new orebodies in the famous *ton for ton* program upon which the Butte mines have depended for so many years. He shared in the surface geological work which culminated in the development of the Poulin and Diamond mines and the reopening of the Orphan Girl mine. His work, however, was not restricted to Butte and although concentrated in the West it included all of the U. S., Alaska, Canada, Mexico, and Poland.

In addition to his association with AIME, which he joined in 1913, he was a member of the Montana Society of Engineers. He served as chairman of the Montana Section of AIME in 1931. Also he had been member of the Society of Economic Geologists since 1928 and was presented an honorary life membership in 1957. He was active in Montana School of Mines alumni programs; he served long as a member of its executive board, was a past president, and currently was associated with the Montana School of Mines Research and Development Foundation. In 1936 his alma mater awarded him the professional degree of geological engineer.

## Correction

The necrology list in the May issue of MINING ENGINEERING, p. 515, carried the name of Walter S. Larsh; the listing was followed by an obituary notice in the August issue, p. 946. Both were based on erroneous information. The editors apologize to Mr. Larsh for the embarrassment this notice has caused him.

**C. W. Kimler** (Member 1949) died March 19, 1960. He was born Feb. 9, 1895, in Knox County, Ill. After graduating from Iowa State College in 1921 he joined Chicago, Wilmington & Franklin Coal Co., where he was in charge of preparation and inspection of eight mines. His experiments in recoking petroleum coke and pitch from 1936 to 1942 led to the granting of a patent. In 1943 he headed a lend-lease mission to Morocco in charge of all coal and associated problems. In 1948 he was chief of Coal Section, U.S. Military Government in Korea. Following that assignment he took up residence in Paris, France, as sales engineer, coal section, ECA, as part of the Marshall Plan operation. At the time of his death he was with the Arizona Highway Dept. in Phoenix.

**Andrew W. Morek** (Member 1959) died recently. A student member, he had expected to graduate from Syracuse University this year. He was born in Steuben County on May 1, 1938.

**H. H. Crease** (Member 1910) was born in Bristol, England, in 1870 and died nearly 90 years later in Honda, Colombia. His entire career was spent in the mine fields of Colombia, beginning in 1891 when he went to work as an assayer for the Obdulia mine. A year later he became manager of the mine and from then on he served as manager of numerous mines in Colombia. He also was consulting engineer to H. K. Syndicate Ltd. He continued to take an active interest in his profession into his 85th year.

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*The Institute desires to extend its privileges to every person to whom it can be of service, but does not desire as members persons who are unqualified. Institute members are urged to review this list as soon as possible and immediately to inform the Secretary's office if names of people are found who are known to be unqualified for AIME membership.*

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## Necrology

| Date Elected | Name | Date of Death |
|---|---|---|
| 1919 | Raymond Brooks | Aug. 12, 1960 |
| 1916 | William E. Crawford | Unknown |
| 1925 | J. H. Fletcher | July 18, 1960 |
| 1940 | S. T. Harrison | July 30, 1960 |
| 1932 | Stanley W. Johnson | Mar. 25, 1960 |
| 1943 | George Plews | Aug. 13, 1960 |
| 1931 | W. P. Schumacher | Aug. 11, 1960 |

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**Case History From:**

# FRIA, Leading Alumina Producer

**Tests showed high alumina extraction could be made at coarse grind. Advantages were: lower grinding costs and a coarse sand residue from classifier which kept soluble loss to only a trace.**

**PROBLEM:** *Can coarse, high density, fast-settling bauxite ore be agitated in commercial operation?*

*Screen Analysis:* —3/16" x 8 mesh 7%
— 8 mesh x 16 mesh 21%
—16 mesh x 32 mesh 23%
—32 mesh x 49%

*Dilution:* 3:1

*Feed:* Bauxite ore, sp. gr. 3.0 and sodium aluminate solution sp. gr. 1.35, Temperature 105° C.

*Residue:* Sp. Gr. 3.5 due to iron minerals. Settling rate maximum 78 feet per minute.

**FRIA contacted leading manufacturers of Agitators, selected several units for pilot plant tests. Only DENVER Agitators maintained coarse solids in suspension and properly agitated pulp.**

**SOLUTION:**

*Agitators:* 18 Denver Agitators, (2 banks of 8 ea., 2 standby units.)

*Propellers:* 96" diameter.

*Tank Size:* 22' diameter x 20' deep

*Power Requirements:* 70 HP consumed

**RESULTS:** Entirely satisfactory operation plus economy of coarse grind and coarse sand tailings residue.

*This is only one example of many advantages with coarse agitation. We invite your inquiry.*

**DENVER EQUIPMENT CO.**

**1400 17th St., Denver 17, Colo., Phone CH 4-4466**

At new Toquepala mine of Southern Peru Copper Corporation, four Ty-Rock Screens are used at Crushing Plant, one Ty-Rock at the Sample Mill. Ty-Rocks were chosen because of their proven ability to handle large tonnages of ore at exceptionally low cost per ton. Ty-Rock fully controlled vibration assures long life.

# TYLER "TY-ROCKS" SCREEN ORE AT LOW COST PER TON FOR SOUTHERN PERU COPPER

For the ultimate in heavy-duty screen performance choose Ty-Rocks. Full information in Catalog 68 — write for free copy.

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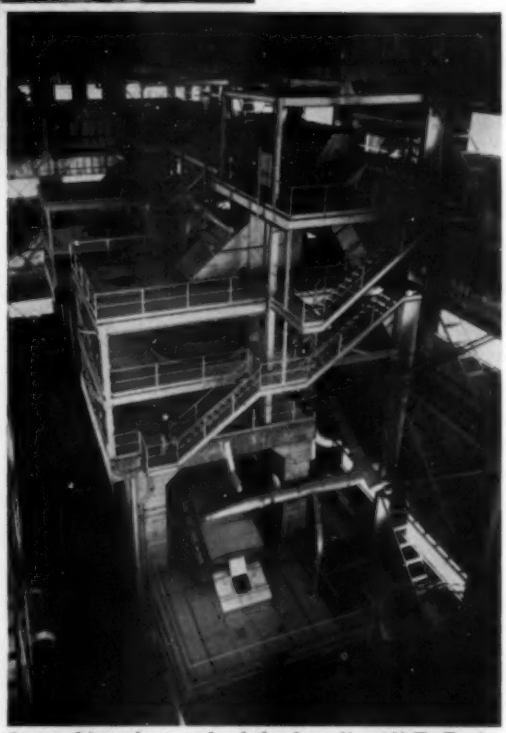
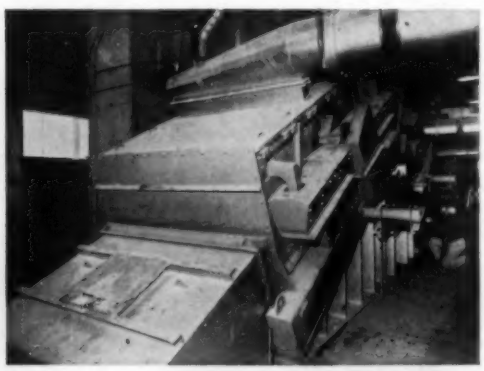


In crushing plant each of the four 6′ x 12′ Ty-Rocks screen 550 tons per hour of minus 2″ porphyry copper ore, 3 to 5% moisture, with approximately 160 tons per hour passing through ⅝″ openings.



Special decks used on these screens are made of abrasion resistant alloys. Service life is long; replacement can be made easily.

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